Building Up while Building Out:

Residential Infill and Smart Growth Development in Metro Atlanta

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I. Introduction

Infill development and smart growth have been among the most popular topics in planning over the last decade. From environmentalists to real estate developers, people across disciplines have been touting the benefits of infill and smart growth. Although specific definitions vary, in general, infill is development that occurs in already heavily urbanized areas, whereas smart growth is a broader land use principle that promotes alternative patterns to sprawling suburban development. Because infill is often a tool and an objective of smart growth policies, the two concepts are commonly presented and analyzed concurrently (Listokin et al. 2006; Landis et al. 2006). For example, Haughey (2001) claims that infill development "tends to be higher density, reuses existing properties, increases property taxes, efficiently uses public resources if infrastructure is already in place, and is less destructive to natural environment than suburban development" (4). These features align with many of the common characteristics of smart growth, which is currently defined as "building urban, suburban and rural communities with housing and transportation choices near jobs, shops and schools" (Smart Growth America 2011).

Although many examples of infill development do share smart growth characteristics, these characteristics are not necessarily a prerequisite for, or a feature of, infill development. Unlike older metro areas in the Northeast and Midwest that have the existing infrastructure to support smart growth infill development, in a newer city like Atlanta, a limited amount of existing areas have smart growth characteristics, such as connected road networks, small lots, and mixed land uses. Consequently, the infill development that occurs in Atlanta does not achieve many of Huaghey's shared smart growth benefits. Based on this hypothesis of non-smart growth infill, this paper seeks to answer the following question: did metro Atlanta's residential infill development built during the boom between 2000 and 2005/09 occur in areas that have smart growth characteristics?

Based on this research question, this paper is broken into five parts. The first two parts provide brief literature reviews of residential infill and residential smart growth. The residential infill development section provides a definitional overview of infill and a synopsis of the different approaches infill studies have taken, while the smart growth characteristics section provides an overview of the different definitions of smart growth. Based on the findings of the infill literature review, the third section creates four different scenarios for defining infill boundaries in the 10 county metro Atlanta region. These scenarios include using the Census defined 1990 Urban Area, incorporated areas with a housing unit density greater than two per acre, incorporated areas with a median year of structure built before 1975, and the City of Atlanta boundary. For each of the infill scenarios, the characteristics of the tracts in 2000 and the characteristics of development from 2000 to 2005/09 are profiled. The fourth section then explores smart growth in Atlanta through the development of a smart growth index. Based on academic and practitioner smart growth literature, twelve variables were selected and then profiled in the paper. An aggregated smart growth index is then created with profiles of the year 2000 characteristics of high, medium, and low smart growth areas and the development that occurred during the 2000s. The fifth section then explores the smart growth characteristics of each infill scenario by overlaying the smart growth index and infill boundaries to determine if the infill development in Atlanta during the 2000s occurred in medium or high smart growth areas.

II. Defining residential infill

Although the concept of infill development is widely discussed by literature in different disciplines, infill has no singular definition. Broadly, infill development is the new development of vacant lots or redevelopment of existing properties in already developed areas (Listokin et al. 2006). Earlier articles define "already developed areas" as the city boundary (Danielsen, Lang, and Fulton 1999; Haughey 2001). Based on this traditional city definition of infill, both Farris (2001) and Steniacker (2003) limit their infill study boundaries to "residential development occurring within the city limits of the major city(s) in the MSA" (Stenacker 2003, 497). A number of studies look at infill development across the urbanized areas of an entire metro area or region (Metro Council 2009a; Sandoval and Landis 2000). In a statewide analysis of potential sites for infill, Landis et al. (2006) classify three types of "infill counting areas" based on different combinations of incorporated areas and unincorporated areas that include minimum densities. These "infill counting areas" are more expansive and include both the urban locations commonly associated with infill, as well as older suburban neighborhoods and some higher-density, newer suburbs (Landis et al. 2006). Wiley (2007) and Charles (2011) further challenge the traditional urban definitions by studying infill development in primarily suburban areas. Wiley explores new infill residential development in the mostly suburban Montgomery County, MD, and Charles looks at single-family redevelopment in suburban Chicago. Given the significant development occurring in older suburban areas, studies can no longer limit the definition to an MSA's core, central city. For a breakdown of different infill studies, see Appendix 1.

In addition to the different boundaries for classifying infill, there is not a consistent view of what types of development should be classified as infill. Some texts limit infill definitions to the development of new buildings on vacant sites (Wiley 2007; Steinacker 2003; Farris 2001). Other texts explore only the redevelopment of existing properties (Charles 2011; Dye and McMillen 2007; Rosenthal and Helsley 1994). McConnel and Wiley (2010) recognize the challenges of infill classification, stating “there is the issue about whether infill development should include redevelopment efforts, in which existing building is replaced with new structures at higher density or mixed uses” (8). Landis et al. (2006) address this issue by expanding their definitions to refill parcels, which includes both vacant parcels and underutilized parcels. In their study, they use tax assessment information to define vacant parcels as being “urban, privately owned and available and feasible for potential development” (686). They define refill parcels as “privately owned, previously developed parcels with a structure valued at $5,000 or more, but for which the improvement-to-land-value (I/L) ratio is less than 1.0 for commercial and multifamily properties and less than .5 for single family properties” (687). Because of land assessment definitions and increased subdivisions, Portland’s Metro Council (2009a) divides vacancy into two categories: “vacant lots” that have never had any building(s) developed on them and “infill lots” that do not currently, but at some point was considered developed (primarily from subdivision). The Metro Council also looks at redevelopment sites.

III. Defining residential smart growth

Like the definition of infill development, smart growth also has variations in its definition, which have advanced overtime. Although O'Neill (2000) states that the term smart growth was first coined in 1988 to contrast with sprawl-style growth, it took the next decade for the term smart growth to be adequately defined. The term smart growth may have been new in the 1990s, but Richmond (2000) notes that many of the principles of smart growth have been a part of planning practice for some time, including "carrying capacity" in the 1970s, "growth management" in the 1980s, and "sustainable development" in the 1990s. Other planning and development trends sharing the underlying principles of smart growth grew rapidly during the 1990s, including New Urbanism, urban villages, traditional neighborhood development, and transit oriented development. The rise and popularization of smart growth as a planning concept and policy tool are directly related to these other trends that seek to counter sprawl development.

By the late 1990s, more explicit definitions, frameworks, and principles of smart growth were emerging. Danielson et al. (1999) provide a widely-cited list of general principals of smart growth land use patterns, as well as more specific principals for residential housing (Table 1). The list by Danielson et al. begins to provide a tangible and more holistic set of principles that policy makers, developers, and communities can work to implement. Rather than defining smart growth as zoning for dense uses, this list expanded the definition to include broader topics, such as connected road networks and alternative transit options, mixing uses and providing amenities, and creating local and regional growth boundaries.

Table 1: Smart Growth Principles

General Smart Growth Land Use Principles	Residential Smart Growth Land Use Principles
1. Reuse existing infrastructure and land resources to the greatest extent possible 2. Encourage and make possible alternative transit modes 3. Reduce the number of vehicle miles traveled 4. Improve an area's job/housing balance 5. Mix land uses to the finest grain the market will bear and include civic uses in the mix 6. Concentrate commercial development in compact centers or districts 7. Reduce community opposition to growth.	1. Promote denser subdivisions in suburbia 2. Encourage urban infill housing 3. Place higher density housing near commercial centers and transit lines 4. Phase convenience shopping and recreational opportunities to keep pace with housing 5. Transform subdivisions into neighborhoods with well-defined centers and edges 6. Maintain housing affordability through mixed-income and mixed-tenure development 7. Offer diverse housing options, including life-cycle housing.

Source: Danielson et al. 1999, Pgs. 517-518

Many texts during the early 2000s, summarized by Lee and Leigh (2005), define smart growth in similar ways with emphasis on different principles. This emphasis on different principles is not surprising given the range of groups involved with implementing smart growth includes transportation, environmental, economic development, affordable housing, and urban design and the range of perceived and documented benefits. For example, some definitions of smart growth are broad and not prescriptive, such as "growth that fosters economic vitality in community centers while maintaining the rural working landscape" (Vermont Forum on Sprawl 2003). Others describe smart growth for its societal goals; Nelson (2001) defines "Smart growth as a set of policies designed to achieve five goals (1) preservation of public goods; (2) minimization of adverse land use interactions and maximization of positive ones; (3) minimization of public fiscal costs; (4) maximization of social equity; and (5), very broadly, maximization of quality of life" (1). Others provide clearer smart growth principles, such as Smart Growth America (2003), which states "smart growth is well planned development that protects open space and farmland, revitalizes communities, keeps housing affordable, and provides more transportation choices." Downs (2005) provides a more recent synthesis of the smart growth literature by breaking it down into six universal principals and three less universal principles (Table 2). Downs' principles, which serve as an update to Danielson *et al*.'s list, are a base to understand much of the smart growth research, measurement, and quantification.

Table 2. Downs' Principles of Smart Growth

Universal Principles	Less Universally Advocated Principles
1) Limiting outward extensions of new development in order to make settlements more compact and preserve open spaces. This can be done via urban growth boundaries or utility districts. 2) Raising residential densities in both new-growth areas and existing neighborhoods. 3) Providing for more mixed land uses and pedestrian friendly layouts to minimize the use of cars on short trips. 4) Loading the public costs of new development onto its customers via impact fees rather than having those costs paid by the community in general 5) Emphasizing public transit to reduce the use of private vehicles 6) Revitalizing older existing neighborhoods.	7) Creating more affordable housing 8) Reducing obstacles to development entitlement 9) Adopting more diverse regulations concerning aesthetics, street layouts, and designs

Source: Downs (2005)

IV. Infill Residential Development in Atlanta: 2000 to 2005-2009

The first part of this study classifies areas where new development could be considered infill. First, an overview is provided of four different infill scenarios with discussions of the rational, the methodologies, and specific strengths and weaknesses. For each of these four scenarios, the second section presents geographic, population, and housing characteristics for year 2000. The third section then analyzes the development that occurred both inside and outside of each infill boundary scenarios between 2000 and 2005/09.

Development of Four Scenarios

Scenario 1: 1990 Urban Area

The first scenario, using the U.S. Census definition of urban area, provides a simple method for defining an infill boundary. The urban area is most similar to the Sandoval and Landis 2000 study of infill capacity in the nine county San Francisco Bay Area. In this study, the researchers used the 1996 urban footprint, based on California Farmland Mapping and Monitoring Project, to define the boundary. Although the urban footprint used a higher density than the Census urban area, unlike many other studies (Farris 2001; Landis et al. 2006; Dye and Mcmillen 2006), it did not limit the boundary to incorporated areas. In a metropolitan area like Atlanta, where a significant portion of developed land is located in unincorporated areas, the use of Census urban areas helps to minimize the exclusion of potential infill tracts.

Since the early 1900s, the U.S. Census has been defining urban areas. Prior to 1950, the definition of an urban area was limited to incorporated areas with populations greater than 2,500 people. Beginning in the 1950s, however, the methodologies used to measure urbanized areas became more sophisticated to better reflect the nation's changing settlement patterns

(Department of Commerce and Census Bureau 2011). By 1990, the measurement of urbanized areas was reliant primarily on density. The U.S. Census defined a 1990 Urbanized Area as “one or more places ("central place") and the adjacent densely settled surrounding territory ("urban fringe") that together have a minimum of 50,000 persons” (U.S. Census 1995). Basing the measurements on block group population data, places are defined as incorporated areas with populations greater than 2,500, whereas urban fringe is defined as a contiguous area that has populations of more than 1,000 people per square mile. Urban fringe also includes the areas that are connected directly by road to the “central place,” extending 1.5 miles from the road (U.S. Census 1995).

With its inclusion of urban fringe and unincorporated areas, the Census definition of an urbanized area makes for an expansive infill boundary. Because it includes more than just incorporated areas, but all areas that connect to places and have minimum population densities of 1000 people per square mile, many Census tracts that are minimally developed are included. 1000 people per square mile equates to only 1.56 people per acre. For some context, Sandoval and Landis urban footprint was based on 1.5 housing units, or between 3 and 4 persons, per acre.

Because of this wide inclusion of low density areas, it is appropriate to choose an older urban area boundary for an infill analysis. In this scenario, Atlanta’s 1990 Urbanized Area was used. Even with the 1990 boundary, however, because of the low density requirements and Atlanta’s sprawling development patterns, many areas have been included that would generally not be considered infill. For fast growing and sprawling cities like Atlanta, an even older urbanized area boundary may better reflect infill boundaries. For a more compact, slower growing city, a more recent urbanized area could still be used.

Despite the weaknesses of the urbanized area reflecting infill geographies, the boundary presents a number of strengths for this project. For one, it is a simple measure to use. The U.S. Census already has determined the boundary and because it is based on Census geographies, it aligns well with other commonly available data. Secondly, if this study were to be replicated in other cities, the use of a Census urbanized area does not require any new processes except determining which year to use. Finally, because the methodology includes both incorporated and unincorporated areas, it is more inclusive than the three other methods used in this paper. In metro areas with low levels of incorporation, the inclusion of non-incorporated areas provides a more accurate assessment of infill.

Scenario 2: Incorporated areas with housing units greater than 2 per acre

The second method of defining the infill boundary is based on density and incorporated areas. Using density to define infill boundaries is the primary way many studies have defined urban boundaries (Landis et al. 2006; Wiley 2007). Landis et al.'s capacity study of California analyzes three different scenarios all based on housing unit density at the Census block level. The widest counting area had a cut off of 2.4 dwelling units per acre or more in incorporated areas; the middle area requires a density of 2.4 dwelling units per acre (regardless of its located in an incorporated or unincorporated area) and also includes all urban commercial and industrial areas; and the narrowest area scenario includes only incorporated areas in coastal areas with a density greater than 4.0 units per acre and in inland counties with greater than 3.2 units per acre. In a report on infill in Montgomery County Maryland, Wiley (2007) sets a density of 2.0 units per acre. Especially for exploring areas at or greater in size than a county, using unit density provides a relatively simple method for defining infill.

Based on the previous examples, different densities within incorporated areas were tested. After trying multiple densities ranging from one to five housing units per acre across a Census tract, like Wiley (2007), two units per acre was selected because the boundaries seemed to best reflect the metro area's built-out areas. The use of two units per acre provides a much smaller and more representative boundary than the 1990 urbanized area. Moreover, older, closer in areas typically are more built out than newer areas that are still in the process of developing, so the two units per acres provides a strong boundary for a metro area like Atlanta.

Although this methodology is intuitively strong, it has a number of weaknesses in capturing the areas of infill. First, only incorporated areas are included, which for this study, significantly limits the areas that could even be classified as infill. In the case studies that used density in incorporated areas, the regions' areas of incorporation better aligned with development. In Atlanta, however, unincorporated areas often have significant development. For example many areas in DeKalb County, which were developed originally in the 1960s and are currently built out, remain unincorporated, and consequently, are not included in this method. Second, because the average density is calculated at the Census tract level, the calculation may not reflect the realities of the development spread across the Census tract. While this presents greater problems for large Census tracts, for this project, which is concerned with older Census tracts, the tracts of concern are smaller in area, and therefore, have greater consistency in development across the tract. A more rigorous approach may explore densities at the block group level and then classify the tract based on the percentage of block groups or some other proxy.

Scenario 3: Incorporated areas with median year of structure built before 1975

Using the median year that structures were built (median age) at the Census tract level provides an alternative to the density method. The median age effectively provides a check to the more popular density boundary methodology. The median age is especially useful for tracts where the population density may not properly indicate the tract's development and infill potential. These tracts may be developed at a low density (as is the case of Atlanta's Buckhead neighborhood), may still have significant amounts of space dedicated to parks, preservation land or water, or may be developed as a non-residential use. In addition to providing a check to the density, by using housing age, older areas are included that may have lost populations. These areas may not show up for housing unit or population density, but may have the infrastructure that supports the concept of infill (see previous discussion).

When using the median year a structure was built to create a boundary, the primary decision is to determine which year to use as a cut off. This example used three steps in determining the age. First, the Census 2000 median year structure built was mapped by Census tract to create a geographically-based visualization of the timeline of Atlanta's development. As expected, the older housing is concentrated near the urban core with a few tracts in Marietta, which has a historic downtown with old homes. Second, the 1975 cut off was then determined by calculating a weighted average across the 10 counties Census tract for housing age. The result was an age between 1975 and 1976. This 1975 cut off provided an area that was too large and did not properly reflect the reality of infill, so the third step involved including only tracts in incorporated areas.

While there are certainly merits to using the median housing age, there are some underlying weaknesses. First, the cutoff age is somewhat arbitrary. In this case, the weighted average seemed to align with the areas that intuitively were appropriate for defining infill, but this is not necessarily the case in all metro areas. A more rigorous methodology to determine the cut off should be explored to use this metric more rigorously. Second, as in the density scenario, the median is applied to an entire Census tract, which may not properly convey the differences within a tract. When looking at a sample of older tracts in Atlanta, most housing is built at about the same time; however, when more infill occurs in the future, this median might not be the most appropriate measure.

Scenario 4: City of Atlanta Boundary

The City of Atlanta Boundary is conceptually the simplest and earliest infill methodology. Using a city boundary has its precedent in two well-cited studies (Farris 2001; Steinacker 2003) that measure infill development in central cities in comparison to the entire metro area. Both Farris and Steinacker use similar methodologies of calculating the ratio of new residential units in a city to total residential units in the MSA. Farris looks at new infill housing in 22 cities from 1989 to 1998 and finds that “new units being built in central cities is limited, compared with their respective metropolitan areas” (2). Overall, these central cities have 29.1 percent of the total 1990 metropolitan housing stock, yet only attract 5.2 percent of the total units constructed during the decade. Farris concludes that all the discussion and excitement surrounding infill is not warranted. Steniacker uses a similar methodology, but adjusts for available land. When dividing the ratio of new city residential units to new metropolitan units by the ratio of land in the central city to the metro area, Steincaker finds that overall “cities are constructing at least their fair share of new housing given the geographic size” (497). The study applies the methodology to 68 different metropolitan areas for total housing units, single family housing units, and multifamily housing units. Overall, as expected, when calibrated for land, multifamily units are the major driver of increases of infill units. Given these two studies define infill as occurring only in cities, total infill for the metro area, especially for single family in older suburbs, is under counted.

This method delineates the city from the surrounding suburbs along an arbitrary boundary line. In a city with development patterns like Atlanta, only using a city's boundary has many weaknesses. First, although boundaries are important for taxation and services, unless the boundary is based on geography (i.e.) the Hudson River and East River for Manhattan) or manmade obstacle (i.e.) a railroad or highway), it has few relations to development patterns. Much of the development both inside and outside of the City of Atlanta boundary should be classified as infill. The question of the city limits is made more irrelevant in a metro area like Atlanta where the land area is such a small part of the entire metropolitan area. Conversely, in metro areas where the boundary of the central cities is large, areas of the city may be newer or less developed and, therefore, not necessarily considered infill.

Characteristics of Infill Scenarios in 2000

The geographic characteristics vary for each of the four scenarios (Map IV.1 and Table IV.2). Scenario 1, the urbanized area, has the largest area, including 64% of the metro's land area, or nearly 2000 square miles. It is the only scenario that includes tracts from all 10 counties. Scenario 2, based on housing unit density, is significantly smaller representing only 6% of the metro area, or a little less than 200 square miles. Although most of the area is primarily in the core, some areas that are not included are Atlanta's Buckhead neighborhood, which has low density, and Sandy Springs, which was not yet incorporated in 2000. Large areas of Roswell and small parts of Marietta are also included in Scenario 2. Scenario 3, based on structure age, is a similar size to Scenario 2, measuring 7% of the 10 counties' land, or 201 square miles. Unlike Scenario 2, Scenario 3 includes most of Buckhead, larger portions of Marietta, as well as areas in the southwest part of the city. It does not include areas in North Fulton County. Scenario 4, the City of Atlanta, only accounts for 6% of the metro area's land, or 194 square miles.

Map IV. 1 Four Infill Scenario Maps

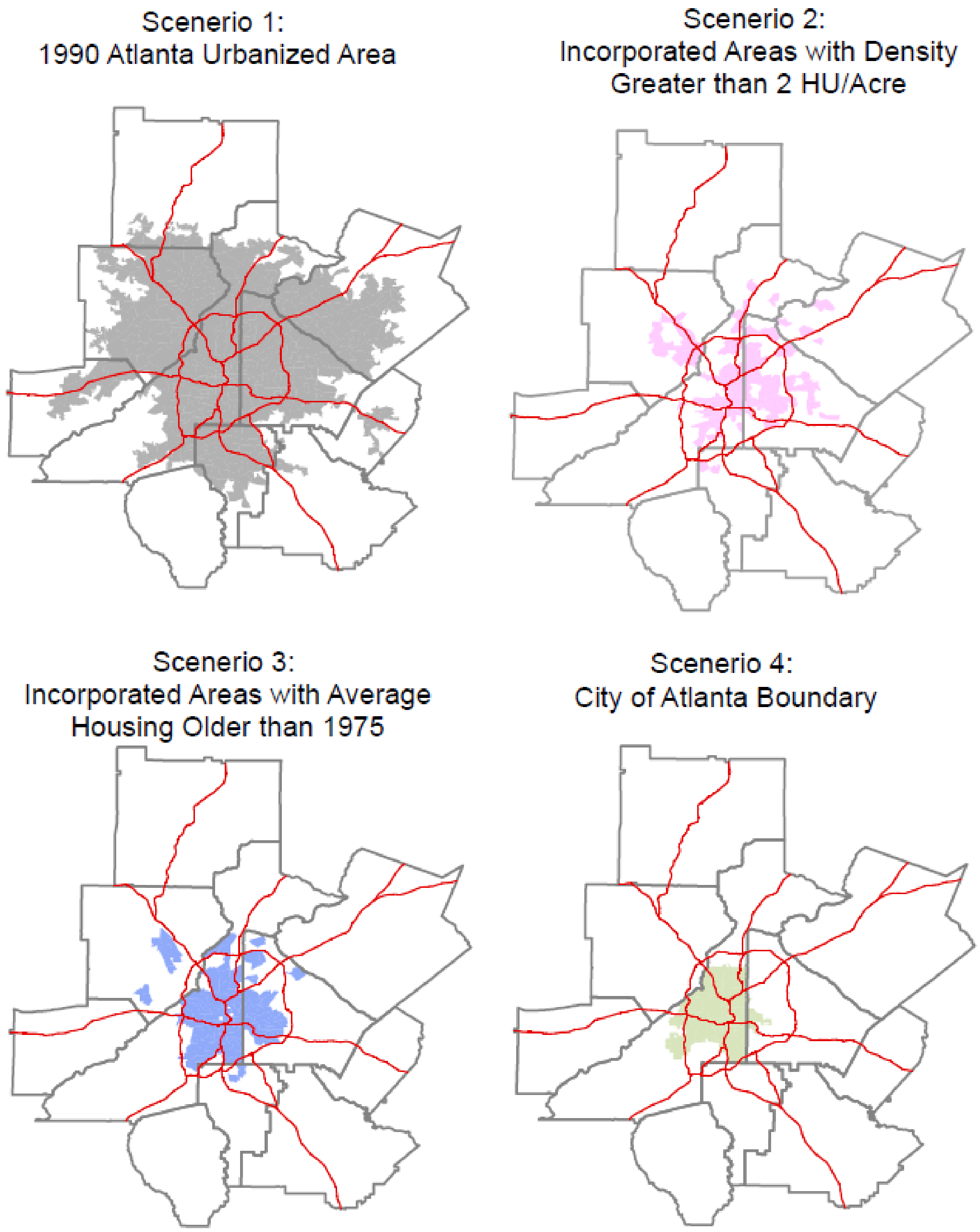


Table IV.2 Characteristics by Scenario, Year 2000

		Scenario 1				Scenario 2				Scenario 3				Scenario 4			
	10 County Metro Area	1990 Atlanta Urban Area		Outside Scenerio 1		Incorporated Area with HU Dens > than 2 per acre		Outside Scenerio 2		Incorporated Area with Median Housing Age Older than 1975		Outside Scenerio 3		City of Atlanta Boundary		Outside Scenerio 4	
Area (Sq Mi)	3021	1938	64%	1082	36%	194	6%	2826	94%	201	7%	2819	93%	194	6%	2827	94%
Population	3,429,379	3,128,367	91%	301,012	9%	815,303	24%	2,614,076	76%	641,454	19%	2,787,925	81%	487,229	14%	2,942,150	86%
Total Housing Units	1,331,264	1,222,998	92%	108,266	8%	377,444	28%	953,820	72%	275,110	21%	1,056,154	79%	217,766	16%	1,113,498	84%
Single Family Units	891,759	798,179	90%	93,580	10%	152,972	17%	738,787	83%	145,970	16%	745,789	84%	105,923	12%	785,836	88%
Multifamily Units	410,497	402,271	98%	8,226	2%	222,661	54%	187,836	46%	127,303	31%	283,194	69%	110,863	27%	299,634	73%

In all four scenarios, the infill boundaries had a much higher percentage of the 2000 population than the land percentage (Table IV.2). Scenario 1, with 64% of the land, has 91% of the population; Scenario 2, with only 6% of the land, has 24% of the population; Scenario 3, with 7% of the land, has 19% of the population, and Scenario 4, with 6% of the land has 14% of the metro area's population.

These results match intuition. The Census urbanized area—even using a boundary that is older—should include nearly all of a metropolitan area's population. Likewise, areas with a minimum housing unit density should also have a disproportionate part of the population. This ratio of a quarter of the population living on six percent of the metropolitan area's land makes sense even in a metro area with as much low density development as Atlanta; the huge overall area helps to drive down the dense land area to only six percent. It is also not surprising that both the older housing areas and the city of Atlanta have less population than the densest areas in the metro area. So much of even the older housing stock is low density. Moreover, in the City of Atlanta, there is also a significant amount of land that does not have housing with the result of lowering the overall population that lives in the city limits.

The total housing units in 2000 follows a similar trend to the population distribution (Table IV.2). Scenario 1 has 91% of the housing units; Scenario 2 has 28% of the housing units; Scenario 3 has 21% of the housing units; and Scenario 4 has 16% of the housing units. Although the general patterns are similar, it is interesting that the percentage of units is slightly higher than the percentage of population. This difference can be explained by a number of possible reasons. The area within the infill boundaries has a lower number of persons per household. The areas also have a higher number of vacant housing units. Even though no one lives in these units, they are still counted.

In terms of single family units in the infill boundaries, in all instances, the percentage of units is less than the population percentage (Table IV.2). The most drastic difference is in Scenario 2, where single family units are seven percentage points below the population percentage (17% versus 24%). This intuitively makes sense because Scenario 2 is based on density, so fewer single family units will be in the area. Scenario 1 has the lowest difference (90% single family units versus 91% housing units). This also makes sense because Scenario 1 is the most inclusive of more suburban areas that are primarily with single family units.

Contrary to single family unit distribution, for all four infill scenarios multifamily units are much more concentrated within the boundaries (Table IV.2). For multifamily units, Scenario 1 accounts for 98%; Scenario 2 accounts for 54%; Scenario 3 accounts for 31%; and Scenario 4 accounts for 27%. Moreover, when looking at what percentage of total housing units are multifamily, the ratio of multifamily to single family is higher for multifamily in the infill scenarios. Scenario 2 has the highest multifamily proportion (59% multifamily versus 41% single family), which is the result of the Scenario 2 boundary being based on housing unit density. Within the city of Atlanta, roughly half of the units are single family and half are multifamily, and in Scenario 3, there is a bit higher proportion of single family (53% versus 47% multifamily). Although these scenarios have higher percentages of multifamily than the metro average of two-thirds single family to one-third multifamily, the low multifamily percentages reveal just how much of even the infill areas are dedicated to single family housing.

Infill Development from 2000 to 2005/09

During the well-documented housing boom from 2000 through 2008, the Atlanta metro area saw the creation of over 326,000 new housing units in both infill and non-infill locations, or an increase of 25% from 1.33 million to 1.66 million (Table IV.2). Single family units, which represented approximately 79% of the new units in 2000, increased by 29%, or 256,000 units. Multifamily units, which represented 21% of the new units in 2000, increased by 17%, or 70,000 units. This 25% increase in total housing units was four percentage points higher than the increase in population, which increased by over 700,000 people, or 21%. This higher growth in housing units compared to population offers one clue into the severity of the downturn in Atlanta’s real estate market.

Growth rates for the different infill scenarios vary significantly. The City of Atlanta had the highest overall growth rates in single family units, multifamily units, and total units. The 1990 Urban Area had the second highest growth rates, which were generally similar to Scenario 3, the median age scenario. Scenario 2, based on housing unit density, had the lowest growth rates in all categories.

Scenario 1: 1990 Urban Area

Scenario 1 had the most extreme differences between growth inside and outside the boundary. The areas within the boundary had growth rates that followed a similar pattern to the metro wide averages, albeit slightly lower (Table IV.4). Total units increased by 21% versus 29% overall, multifamily units increased by 16% versus 17% overall, and single family units increased by 24% versus 29% overall. The relatively small differences in growth rates can be attributed to the drastic increases outside of the urban area boundary. Total units outside the boundary increased by 66%, multifamily units increased by 93%, and single family units increased by 69%. These high growth rates indicate the significant growth in the metro area’s most distant suburbs during the boom; however, the rates can be a bit misleading because of the relatively low basis. For example, inside the urban area, 255,265 new units, or roughly 78% of metro-wide total new units, accounted for only a 21% increase; however, outside the urban area, the 70,934 units, or roughly 22% of metro-wide total new units, represented a 66% increase.

Table IV.4. Scenario 1: 1990 Atlanta Urban Area

	Total Units				Single Family				Multifamily			
	2000	2005/09	Change	% Change	2000	2005/09	Change	% Change	2000	2005/09	Change	% Change
Inside	1,222,998	1,478,263	255,265	21%	798,179	990,790	192,611	24%	402,271	464,949	62,678	16%
% Total	92%	89%	78%		90%	86%	75%		98%	97%	89%	
Outside	108,266	179,200	70,934	66%	93,580	157,716	64,136	69%	8,226	15,868	7,642	93%
% Total	8%	11%	22%		10%	14%	25%		2%	3%	11%	

Scenario 2: Incorporated areas with housing units greater than 2 per acre

Scenario 2, the incorporated areas with housing units greater than 2 per acre, had the lowest growth rates. Total units increased by 14%, or 52,431; multifamily units increased by 9%, or 20,903 units; single family units increased by 20% or 29,973 (Table IV.5). A much higher amount of the growth, both in real terms and growth rates, occurred outside of the boundary. Outside of the Scenario 2 boundary, total units increased by 29%, multifamily units increased by 26%, and single family units increased by 31%. This high non-infill growth rates caused the concentrations of housing within the boundary to decrease the most of the four scenarios. The infill boundaries share of total units decreased from 28% to 26%, multifamily decreased from 54% to 51%, and single family decreased from 17% to 16%. Using Scenario 2 does not make the case for infill in Atlanta.

Table IV.5. Scenario 2: Incorporated Area with HU Dens > than 2 per acre

	Total Units				Single Family				Multifamily			
	2000	2005/09	Change	% Change	2000	2005/09	Change	% Change	2000	2005/09	Change	% Change
Inside	377,444	429,875	52,431	14%	152,972	182,945	29,973	20%	222,661	243,564	20,903	9%
% Total	28%	26%	16%		17%	16%	12%		54%	51%	30%	
Outside	953,820	1,227,588	273,768	29%	738,787	965,561	226,774	31%	187,836	237,253	49,417	26%
% Total	72%	74%	84%		83%	84%	88%		46%	49%	70%	

Initially, these figures were surprising, especially for the multifamily housing units. Intuition is that areas with greater density would have had higher growth rates because of potential "back to the city" movement. However, on closer analysis of the tracts with density, many were in areas that were already built out and could not support new housing. If new housing was built, it would have been a replacement of the existing houses. Large parcels of land to support multifamily development were also less frequent in these tracts. Although some of these dense tracts certainly saw very high growth, many of these tracts in poorer areas actually had decreases in the number of housing units. Of the four scenarios, these reductions were most prevalent in scenario 2, which dampened the overall growth rates.

Scenario 3: Incorporated areas with median year of structure built before 1975

Scenario 3, incorporated areas with older housing, had growth rates that were close to or exceeded metro averages. Total units increased by 21% compared to 25% overall, while single family units increased by 21% compared to 29% overall (Table IV.6). Multifamily growth in scenario 3 actually exceeded overall growth by 2 percentage points, or 19% compared to 17% overall. Multifamily within the boundary of scenario 3 represented about 34% of total growth in multifamily units in the metro area. Of the four scenarios, the growth outside of scenario 3 was closest to the metro wide average, at 26% for total units, 16% for multifamily units, and 30% for single family units.

Table IV.6. Scenario 3: Incorporated Area with Median Housing Age Older than 1975

	Total Units				Single Family				Multifamily			
	2000	**2005/09**	**Change**	**% Change**	**2000**	**2005/09**	**Change**	**% Change**	**2000**	**2005/09**	**Change**	**% Change**
Inside	275,110	331,554	56,444	21%	145,970	177,084	31,114	21%	127,303	151,375	24,072	19%
% Total	21%	20%	17%		16%	15%	12%		31%	31%	34%	
Outside	1,056,154	1,325,909	269,755	26%	745,789	971,422	225,633	30%	283,194	329,442	46,248	16%
% Total	79%	80%	83%		84%	85%	88%		69%	69%	66%	

Scenario 4: City of Atlanta Boundary

Whereas Scenario 3's growth rates were close or minimally exceeded overall growth rates, the City of Atlanta boundary had growth rates that significantly exceeded the overall rates. Total units increased by 29% compared to 25% overall; multifamily units increased by 25% compared to 17% overall; and single family units increased by 33% compared to 29% overall (Table IV.7). These sizeable differences support the notion that significant amounts of infill occurred in Atlanta. Because of these higher growth rates, housing for the region became slightly more concentrated within the boundary of Scenario 4. The City of Atlanta accounted for 16% of total units in 2000 and 17% in 2005/09; multifamily units accounted for 27% and 29%, respectively; and single family units remained steady at 12%. Although growth rates were high in the city limits, outside of the city, growth remained strong with an increase of 24% of total units; 14% of multifamily units; and 28% of single family units. Moreover, although the changes in real numbers of total units, multifamily units, and single family units were higher than scenarios two and three, these growth rate trends are further amplified by the smaller number of units in the city limits compared to within the boundaries of other scenarios.

Table IV.7. Scenario 4: City of Atlanta Boundary

	Total Units				Single Family				Multifamily			
	2000	**2005/09**	**Change**	**% Change**	**2000**	**2005/09**	**Change**	**% Change**	**2000**	**2005/09**	**Change**	**% Change**
Inside	217,766	281,133	63,367	29%	105,923	140,742	34,819	33%	110,863	138,412	27,549	25%
% Total	16%	17%	19%		12%	12%	14%		27%	29%	39%	
Outside	1,113,498	1,376,330	262,832	24%	785,836	1,007,764	221,928	28%	299,634	342,405	42,771	14%
% Total	84%	83%	81%		88%	88%	86%		73%	71%	61%	

V. Smart Growth in Atlanta

In order to measure smart growth attributes, a smart growth index was developed at the Census tract level. An index has been one of the more common ways to measure the potential for or presence of smart growth at all different geographic scales. For example, Bagley et al. (2002) uses 18 variables in their analysis of neighborhood preferences in San Francisco. Rather than relying only on aggregated data, their study uses surveys for 15 variables to provide multidimensional, continuous data for five different neighborhoods. In studying the presence of smart growth and development patterns in Portland, OR, Montgomery County, MD, and Orlando, FL, Song (2005) used variables related primarily to five dimensions of urban form, including street network connectivity, density, land use mix, accessibility, and pedestrian walkability. In a similar study that looks at neighborhood typologies in areas with new construction in Portland, Song and Knaap (2007) expands the number of variables and categories to measure urban form, including neighborhood design, density and plot design, mixed land uses, accessibility, alternative transportation, and natural environment. In a study measuring travel demand based on areas that have smart growth principles, Cervero and Kockelman (1997) classify 13 variables into three categories: density, diversity and design.

Components of a Smart Growth Index

Based on some of the previous examples, 12 separate variables were selected to measure the multiple dimensions of smart growth. In many examples from the smart growth index literature, which are typically academic articles, the index is presented in aggregate without a discussion of the characteristics of the input variables. In recognizing the variables separately, this paper seeks to provide transparency in the measurements and weights of variables. This openness will allow this index to be tweaked in the future that results in a very different looking index.

Below, each of the smart growth variables is presented with a brief discussion of the rationale. Appendix 1presents details of each variable's methodology, the results, and a discussion of its strengths and weaknesses. Based on the appendix, the methodologies can be further refined in a future index for Atlanta or be replicated for other metro areas around the country.

1. Housing Unit Density in Developed Areas

Housing unit density is one of the most fundamental characteristics of smart growth. Regardless of the definition of smart growth, density is the necessary element that allows the other principles to occur. In order to achieve a self-sustaining mix of commercial and residential, a minimum residential density is required (Cervero and Kockelman 1997). Different types of public transit—be they busses, light rail, or heavy rail—require different densities to have enough ridership. To create neighborhoods with mixed uses that promote walking, residential density is necessary to support the ground level retail espoused by urbanists. In order to protect open space in metropolitan areas, higher densities in existing areas are critical to support growing populations. Although smart growth is so much more than just density, density is its core, underlying principle.

All major studies that measure smart growth, regardless of the specific discipline, include density as either a single variable or represent it through a combination of variables. At the project level, Fleissig and Jacobsen (2002), which uses a scorecard to measure a project's smart growth attributes, includes "site optimization and compactness" to refer to density of a site. Song and Knapp (2007), which focuses more on the urban design elements of smart growth at the neighborhood level, uses multiple variables, including floor space, block size, and lot size, that, when combined, have the effect of measuring density. More broadly, Song (2005) measures density in multiple neighborhoods by single family dwelling unit density, and Bagely et al. (2002) has a population density variable in their study of neighborhoods in San Franisco. Cervero and Kockelman (1997) classifies 13 variables into three categories with density being the first category. Although across studies the actual variables and specific methodologies vary, they all fundamentally measure the presence of density.

2. Marta TOD

An important goal for many smart growth practitioners is connecting land use planning with transit operations. With this in mind, Marta, Atlanta's transit agency, developed specific transit-oriented development guidelines. Marta had four different TOD classifications. The Urban Core classification features the highest density development with a FAR of between 8.0 and 30, a minimum of 75 units per acre, and a height of 8 to 40 stories. Only a few areas, all smaller than a Census tract, can be classified as urban core. TownCenter or Commuter Town Center classification is the next level of intensity with a FAR of 3.0 to 10.0, a density of between 25 and 75 units per acre, and a height of 4 to 15 floors. This type of development is the more traditional development density surrounding transit stations throughout a system. Finally, a neighborhood classification has a FAR of 1.5 to 5.0, a density of between 15 and 50 units per acre, and a height of 2 to 8 stories. This type of development is more common along corridors or in traditional downturn areas. Using the Marta TOD guidelines provides a variable that captures local policy, rather than some national standard, governing transit-oriented development.

3. Mean Travel Time

An important effect of smart growth—especially for transportation planners—is the ability for design to "degenerate vehicle trips, reduce VMT per capita, and encourage non-motorized travel" (Cervero and Kockelman 1997, 216). Many studies have looked at the effect of built environment on travel patterns. In the study of built environment's effect on trip generation and travel in San Francisco, Cervero and Kockelman (1997) conclude that there is a modest inverse effect of smart growth's density, diversity, and design on travel demand: the higher level of these elements the lower the amount of travel. Krizek (2003) furthers the earlier research by looking at households that moved to neighborhoods with different urban forms and whether the new neighborhood's design affects travel, concluding that urban form does impact household travel. Although these studies caution that results should be interpreted as associative and not causal, the general conclusions they make about reduced travel has intuitive appeal. A mean travel time variable builds off the findings and precedent set by these earlier studies.

4. Commute by Walking

The commute by walking variable was selected as a proxy for a tract's walkability, and more loosely, the presence of local employment. Although commuting by walking, by itself, does not reveal much about smart growth, it does hopefully correlate to other measures of pedestrian-friendly urban design that characterize smart growth. Bagley et al. (2002) includes a few variables associated with walking and pedestrian-friendliness, including whether the neighborhood has "pleasant streets for walking/jogging" and the length of sidewalks. Song (2005) includes variables for pedestrian access to commercial and pedestrian access to bus.

Although these two papers are based on household surveys, commute by walking captures many of the same underlying principles.

5. MARTA: Minimum Tract Distance

Public transit is another area important for smart growth. Local access to a public transit network—be it busses, subways, or commuter rail—provides residents of all ages and incomes with the opportunity to travel beyond their immediate surrounding) without the use of a private automobile. In nearly every smart growth index, public transit is included in some capacity. Bagley et al. (2002) include two variables: public transit nearby and public transit is convent. Song (2005) includes pedestrian access to busy, Song and Knapp (2007) include number of bus stops, and both include a distance to bus stop variable. Flessig and Jacobsen (2002) include "Walking distance to transit" as a scoring metric for access to transit. With forward-thinking land use planning, such as the Livable Centers Initiative, transit can be leveraged to encourage denser, pedestrian-friendly development near stations.

6. PATH: Minimum Tract Distance

Another non-vehicular measure of smart growth is biking. Like walking and transit, suitable infrastructure for biking has increasingly been a feature of smart growth. The argument for biking infrastructure is that with better infrastructure, which typically includes paths, bike racks, and showering facilities, more people will choose biking instead of vehicular travel. The presence of bike infrastructure has the same logic for smart growth as pedestrian infrastructure and transit; better pedestrian infrastructure increases walking and the presence of transit increases transit ridership. Moreover, in order for bike infrastructure, like pedestrian and transit infrastructure, to be fully used, other smart growth qualities, such as density and mixed uses, needs to be present.

Biking as a smart growth variable is found less consistently in different indexes. Many of the studies cited in this paper (Song and Knaap 2007; Song 2005; Krizek 2003) do not include biking as part of their indexes because of the lack of data availability. Flessig and Jacobsen (2002) call for a checklist of elements that "facilitate choices in transportation modes," such as bike racks, bike lockers, and bike paths (12). Cervero and Kocklemen (1997) has the most rigorous approach to "cycling provision" variables, including the proportion of blocks with bike lanes and bike lanes per developed acre. Although biking is a relatively minor variable compared to others in this study, it is worthwhile to include as commuting by biking expands in popularity.

7. Retail Jobs to Population

Nearby access to retail services is an important element of smart growth. Previous studies have measured the presence of retail in different ways. Some studies have variables that measure the distance to specific retail types, such as grocery stores or gas stations (Bagly et al. 2002). Others, such as Song and Knapp (2007) count the number of stores in the area. Cervero and Kockelman (1997)'s dimension of diversity includes a number of variables that proxy retail services, including rates of retail stores per developed acre, proportion of vertically mixed commercial-retail parcels, and proportion of residential cares within ¼ mile of a store. Flessig and Jacob (2002)'s scorecard incudes a measure for "proximity to any one of the following: food/convenience retail/services, schools, daycare, recreation centers" (7). Like these other studies, using a retail jobs to population ratio captures the local density and presence of retail.

8. Street Length Per Square Mile of Developed Area

Different urban design attributes related to streets are important to smart growth. Streets are important for researchers of smart growth from many different disciplines. In exploring the effects design on travel, Krizek (2003) measures the neighborhood's urban design characteristics based solely on streets, exploring the street pattern by calculating block areas and intersection density. Bagely et al. (2002) measure the "grid-like street configuration," while Song (2005 and Song and Knapp (2007) take slightly different approaches of using streets as a variable of smart growth. Song (2005) uses the streets as a proxy for interconnectivity and external connectivity. Song and Knapp (2007) use streets to define urban design by measuring street length, counting the number of intersections and cul de sacs, and comparing block size and neighboring block size. This street length per square mile of developed area has the effect of measuring density in both residential and non-residential areas, and more loosely the presence of smaller block sizes and connectivity.

9. Parks

Parks, and more generally public open space, are integral parts of any community, especially for denser areas. Because households typically have less private outdoor space in denser communities, parks becomes important for quality of life in smart growth areas. Many of the different indexes measure open space, public land, and parks using different variables. Miles and Song (2009) uses two variables, acres of public land and acres of open space in block groups. Bagley et al. (2002) uses a variable of distance to nearest park of playground, which is similar to the distance to nearest park by Song and Knapp (2004). Interestingly, the transportation literature on smart growth (Cervero and Kockelman 1997; Krizek 2003) does not have a variable specific to parks. A park variable ensures this index emphasizes the importance of public open space, even in dense area, for smart growth.

10. Livable Centers Initiative

The Livable Centers Initiative (LCI) is a program started by the Atlanta Regional Commission in 1999 "to help planners and governments more effectively link current and future land use planning to existing or planned transportation infrastructure" (Atlanta Regional Commission 2011, 3). Under the program, grants and technical assistance is provided to communities to work to create more livable places. In year 2000, $1 million in grants were provided to the 12 initial town and activity centers. Because the LCI program supports the active planning of many smart growth principles, it is another strong variable to include in an index specific to Atlanta.

11. Land Use Diversity

After density, mixed land uses are one of the defining attributes of smart growth. One of the theoretically simplest ways to promote "housing and transportation choices near jobs, shops and schools" (Smart Growth 2011) is to have land uses that are mixed and diverse. In nearly every smart growth index, mixed land uses is measured in some way. Cervero and Kockelman (1997) have two specific variables that measure land use diversity; A vertical mixture variable is based on the proportion of commercial/retail parcels with more than one use on them and an activity center mixture looks at the proportion of activity centers with different types of uses in them. Miles and Song (2009) approach mixed land uses not using proportions of different uses, but the actual count of commercial acreage, industrial acreage, public land acreage, and the number of stores in a block group. Fleissig and Jacobsen (2002) even have a specific category, "project is mixed use," that ranks the mixed use based on how many uses are included in the project. This variable goes beyond the density and retail measures to include the mixing of uses occurs at the tract level.

12. Racial Diversity

Although not typically associated with smart growth, I wanted to include a variable that accounts for racial diversity. As demonstrated by the other variables, most smart growth features relate to design and uses. A lot of the social literature on suburbia, however, bemoans its homogeneity of race and income. Similarly, even in many city neighborhoods, many neighborhoods are homogenous by race. Moreover, planning practitioners often call for and theoretically aspire to mixed use, mixed income, racially diverse neighborhoods. For these somewhat abstract reasons, I have included a measure of racial diversity with the higher the diversity being associated with greater smart growth.

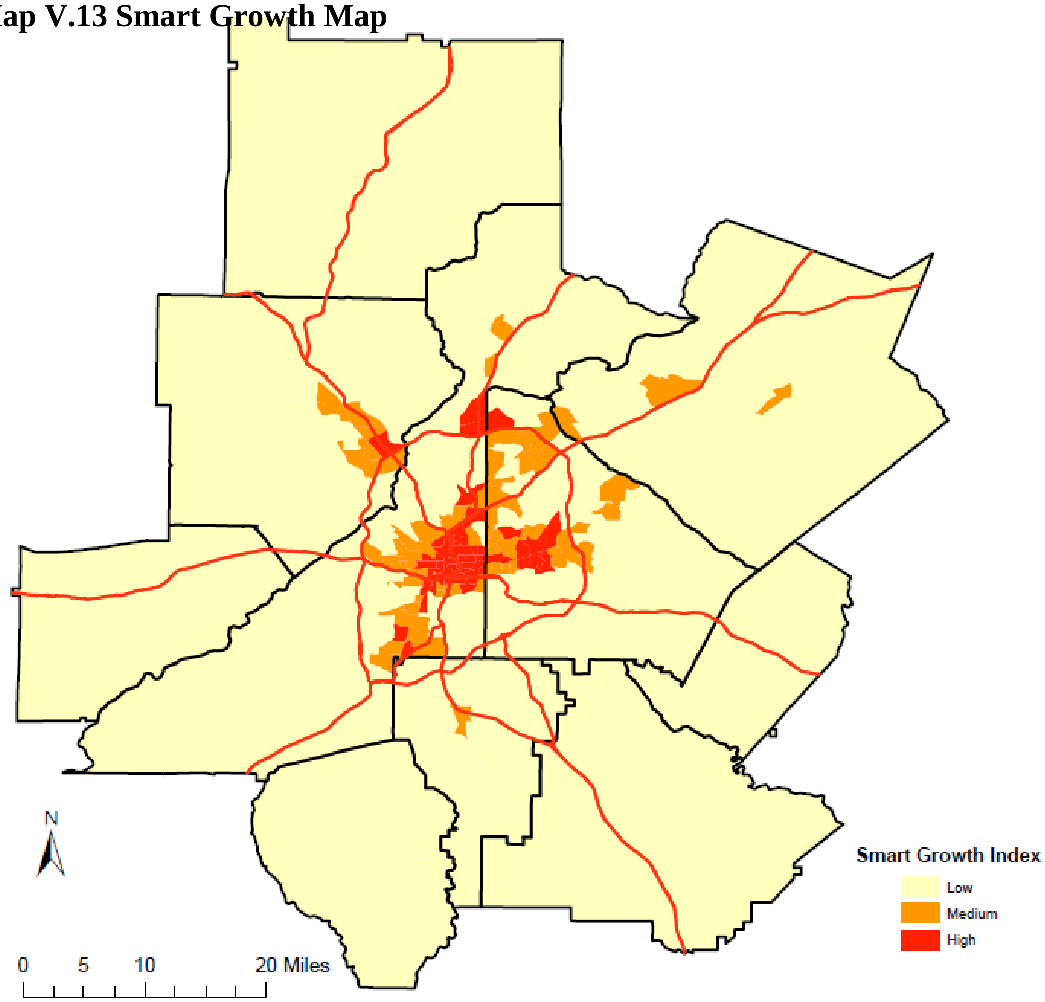
Final Smart Growth Index

Based on the twelve variables discussed above, each tract was given a score and then based on the score was assigned high, medium, and low smart growth. First, the results of each variable for each tract, outlined in Appendix 1, were coded as zero, one, or two. A score of two was associated with greater smart growth and a score of zero was associated with little to no smart growth. For the distance to MARTA and distance to PATH variables, a score of three was given for the nearest tracts to provide greater weight.

After the initial coding, the scores for each tract, based on the 12 variables, were summed. For housing unit density, mean commute time, and street density, the raw number was weighted by two because of their perceived importance to smart growth. This flexible scoring method allows researchers to make changes easily by including new variables or weighting these variables differently.

Overall, the scores ranged from zero to twenty-four. The cut offs were then decided through a process of trial and error. Based on a generalized knowledge of what areas should be considered high and medium smart growth, it was decided that a score of greater than 12 would be considered high smart growth, a score between 8 and 12 would be considered medium smart growth, and below 8 would be considered low smart growth. This resulted in the geographic distribution illustrated in Map V.13.

Map V.13 Smart Growth Map



Smart Growth Geography

High Smart Growth

Based on the smart growth index, high smart growth tracts collectively account for the smallest amount of land in the metro area. Approximately 54 square miles, or slightly less than 1.8% of the total metro area is considered high smart growth in this study (Table V.13). The largest continuous area of high smart growth is, as is expected, at the core of the city of Atlanta, including along the Peachtree corridor from Downtown through Buckhead. Many of Atlanta's older residential neighborhoods, including Inman Park, Virginia-Highland, and Old Fourth Ward, are classified as high smart growth. The second largest contiguous area of high smart growth is in and around the City of Decatur in DeKalb County. These older areas are connected via Marta and bike paths, have higher densities, and include a mix of land uses. The final two areas of high smart growth at at the intersections of I-285 and I-75 and I-285 and GA-400, where, despite urban design that favors the automobile, there is high concentration of dense development, and at the tract level, a mix of land uses. High smart growth tracts are found only in three of the ten counties: Fulton, DeKalb, and Cobb. These counties are also among the earlier counties in the region to develop and also have the smallest Census Tracts that better distinguish nuance in patterns of development.

Table V.13: Land Distribution

	High	Medium	Low	Total
Acres	34,477	104,121	1,794,598	1,933,196
Square miles	54	163	2,804	3,021
%	1.8%	5.4%	92.8%	100%

Medium Smart Growth

Medium smart growth tracts share many similar geographic attributes with the high smart growth tracts. Overall, medium smart growth tracts have an area roughly three times as large as high smart growth tracts, at approximately 163 square miles, or roughly 5.4% of the metro area (Table V.13). Medium smart growth is, generally, adjacent to high smart growth tracts. All tracts, with the exception of one tract in Gwinnett County, are adjacent to or within five miles of an interstate. In fact, medium smart growth tracts essentially connect the core, Decatur, and I-285/GA-400 high smart growth areas. Additional large contiguous areas of medium smart growth are located in the southwest part of the City of Atlanta, northern DeKalb County, and extending along I-75 for a few miles northwest of the perimeter. Medium smart growth tracts are located in five counties: Fulton, DeKalb, Cobb, Gwinnett, and Clayton.

Low Smart Growth

Low smart growth tracts, as expected, make up the vast majority of land in Atlanta. Over 2,800 of the region's 3,021 square miles, or approximately 93%, are considered low smart growth (Table V.13). This is not surprising given the prevalence of suburban style development in all areas of the metro region. All counties have significant amounts of low smart growth development, and the five counties furthest from the center are 100% low smart growth. These five counties, however, also have the largest tracts by area, so smaller areas, such as older downtown areas, may be overlooked by this index methodology at the tract level.

Smart Growth Characteristics

Total housing units in 2000

In 2000, the distribution of housing units varied widely between high, medium, and low smart growth areas. In 2000, the region had approximately 1.3 million housing units, with 111,000 located in high smart growth areas, 211,000 in medium smart growth areas, and 979,000 located in low smart growth areas (Table V.14). Atlanta's housing units were located overwhelmingly in low smart growth areas; however, these numbers do not normalize for the land area of high, medium, or low smart growth areas. Whereas high smart growth land accounted for only 1.8% of the total metro area high smart growth land area, this land accounted for 8.4% of total housing units, or a ratio of units to land of 4.68 to 1; medium smart growth's 5.4% of land area accounted for 16% of total housing units, or 2.98 to 1; low smart growth's 92.8% of land area accounted for 75.6% of total housing units, or .81 to 1 (Tables V.13 and V.15). When normalizing the total number of units for land area, the high and medium smart growth areas accounted for a disproportionate amount of total housing. Given that much of the smart growth index is based on density, this distribution of housing units is expected. High smart and medium growth areas are denser, include more multifamily, and are more built out compared to low smart growth areas, which, in many areas, has significant amounts of undeveloped land.

Table V.14: Smart Growth Unit Count Comparison

		Total Units	SF Units		MF Units	
		#	#	% Total	#	% Total
High	2000	111,122	41,095	37.0%	70,027	63.0%
	% Metro Total	8.4%	4.6%		17.1%	
	2005/09	139,872	52,188	37.3%	87,684	62.7%
	% Metro Total	8.5%	4.5%		18.2%	
	2000 to 2005/09 Change	28,750	11,093		17,657	
	% Change	25.9%	27.0%		25.2%	
Medium	2000	211,878	89,240	42.1%	122,638	57.9%
	% Metro Total	16.0%	10.0%		29.9%	
	2005/09	241,195	111,489	46.2%	129,706	53.8%
	% Metro Total	14.7%	9.7%		27.0%	
	2000 to 2005/09 Change	29,317	22,249		7,068	
	% Change	13.8%	24.9%		5.8%	
Low	2000	979,256	761,424	77.8%	217,832	22.2%
	% Metro Total	75.6%	85.4%		53.1%	
	2005/09	1,248,256	984,829	78.9%	263,427	21.1%
	% Metro Total	76.8%	85.7%		54.8%	
	2000 to 2005/09 Change	269,000	223,405		45,595	
	% Change	27.5%	29.3%		20.9%	
Total	2000	1,302,256	891,759	68.5%	410,497	31.5%
	2005/09	1,629,323	1,148,506	70.5%	480,817	29.5%
	2000 to 2005/09 Change	327,067	256,747		70,320	

Single family and Multifamily units in 2000

When looking at the relationship between single family and multifamily units across high, medium, and low smart growth areas, a number of patterns emerge. In 2000, at the regional level, over two-thirds of the housing units were single family (68.5%) and one-third were multifamily (31.5%). This regional breakdown, however, is not representative of the breakdown in high, medium, and low smart growth areas. High smart growth area had a near inverse of the regional breakdown with only 37% of the units being single family and 63% of the units being multifamily. Although medium smart growth areas had a higher percentage of single family than the high smart growth areas, its unit breakdown still favored multifamily, with 58% multifamily units and 42% single family units. Conversely, the low smart growth areas overwhelmingly favored single family units with nearly 78% of units being single family versus 22% being multifamily.

In terms of the unit distribution between high, medium, and low smart growth areas, the general patterns for single family and multifamily units follow the patterns for the total units. For single family units, 4.6% are located in high smart growth areas, 10% are located in medium smart growth areas, and 85% are located in high smart growth areas. For multifamily units, more units are located in high and medium smart growth areas with 17% and 27% of the units, respectively. Low smart growth areas have a comparatively low 53% of multifamily units. When normalizing for the amount of land using a ratio of unit percentage to land percentage in the three smart growth areas, these distribution patterns become clearer. If units were distributed evenly across the metro area, the ratio would be 1.0. In high smart growth areas, this ratio is 4.68 for total units, but 2.58 for single family units and 9.57 for multifamily units. High smart growth areas have nearly 10 times the amount of multifamily units for the amount of land it accounts versus 2.5 times the single family units. Conversely, in low smart growth areas, this ratio is .81 for total units, .92 for single family units, and .59 for multifamily units. The distribution of single family units to the amount of low smart growth land area is close to the metro average, whereas the multifamily units is almost half of the metro average. Multifamily is much more concentrated in high and medium smart growth tracts.

Table V.15: Ratio of Unit % to Land %

	High	Medium	Low
Total Units	4.68	2.98	0.81
Single Family Units	2.58	1.86	0.92
Multifamily Units	9.57	5.55	0.59

Changes in total housing units 2000 to 2005/09

For total units developed between 2000 and 2005/09, growth was concentrated in high smart growth and low smart growth areas. During this time period, the total units in the metro area increased by over 300,000 units, or 25.1%. These increases were led by low smart growth areas, which, even with a high starting base of 979,256 units, had a total unit increase of 27.5%. Similarly, high smart growth areas saw substantial increases, with a 25.9% increase in the number of units. Growth, while still impressive, was much lower in medium smart growth areas, with an increase of less than 14%. In real terms, however, high and medium smart growth areas had near identical increases in housing units of 28,750 and 29,317, respectively. These patterns of growth caused the distribution of housing to change with total units in high smart growth areas increasing from 8.4% to 8.5% and total units in low smart growth areas increasing from 75.6% to 76.8%. Medium smart growth areas proportion of total housing units decreased from 16.0% to 14.7%. For total units, growth favored low smart growth areas and high smart growth areas; whereas medium smart growth areas were comparatively weaker.

Explanations for these total unit changes can be explained more by the multifamily unit changes, rather than the single family unit changes. Growth rates for single family units across the high, medium, and low smart growth areas were fairly consistent at 27.0%, 24.9% and 29.3%, respectively. Conversely, changes in multifamily across the smart growth types varied with the majority of increases concentrated in high and low smart growth areas. Multifamily units in high and low smart growth areas increased by 25.2% and 20.9%, respectively, whereas in medium smart growth areas, multifamily increased by less than 6%. These patterns of multifamily growth caused the concentrations of multifamily units to increase in high smart growth areas from 17.1% to 18.2% and in low smart growth areas from 53.1% to 54.8%. Multifamily units in medium smart growth areas, however, decreased from 29.9% to 27.0%.

Although there was growth in multifamily, the ratio of single family units to multifamily units increased across high, medium, and low smart growth tracts (Table V.14). High smart growth had the least amount of change. In 2000, 37% of units were single family versus 63% multifamily; in 2005/09, this unit distribution shifted slightly to 37.3% single family versus 62.7% multifamily. With its 24.9% increase in single family units and only 5.8% growth in multifamily, medium smart growth had the greatest distributional change with single family increasing from 42.1% to 46.2% and multifamily decreasing from 57.9% to 53.8%. Even with the development of nearly 46,000 new multifamily units, the distribution of multifamily units in low smart growth areas decreased from 22.2% to 21.1% versus the single family increase of 77.8% to 78.9%. Although there was certainly growth in the denser, multifamily development favored by smart growth practitioners, the boom of 2000s was overwhelming led by lower density, single family development.

Average Household Size

Household size varies widely across the three smart growth areas. In 2000, the region average for persons per household was 2.63. High smart growth areas had the lowest household size of 2.06, medium smart growth's average size was 2.27, and low smart growth's average size was 2.78 (Table V.16). These sizes align with the idea larger families living in single family homes, which are more prevalent in low smart growth areas, while singles and couples live in multifamily buildings, which are more common in higher smart growth areas. Across all areas, however, the average household size shrank during the 2000s. Average household size in high smart growth areas declined the most—by nearly 5%—from 2.06 to 1.97; low smart growth areas declined by nearly 4% from 2.78 to 2.67; medium smart growth declined less than 2% from 2.27 to 2.23. Given the national trends towards smaller household sizes across cities and suburbs, these patterns seem fitting for Atlanta.

Table V.16: Persons/household

	2000	2005/09	Change	% Change
High Smart Growth	2.06	1.97	-0.10	-4.6%
Medium Smart Growth	2.27	2.23	-0.04	-1.7%
Low Smart Growth	2.78	2.67	-0.11	-3.9%
Region	2.63	2.54	-0.09	-3.4%

Vacancy

With the bubbly growth in housing, vacancy rates across all areas soared during the boom. In 2000, high smart growth areas, with its inclusion of poorer and older areas, had the greatest vacancy at 10.6%; low smart growth areas had the lowest vacancy at 4.3%; and medium smart growth was in between at 6.8% (Table V.17). During the 2000s, the number of vacant units increased by 107.7% in high smart growth areas, 153.4% in medium smart growth areas, and over 216% in low smart growth areas. This quadrupling of vacant units in low smart growth areas caused the vacancy rate to climb to 10.7%, which was a greater rate than the high smart growth vacancy rate in 2000. Although this is only one data point, it indicates that throughout the metro area housing was overbuilt during the boom. It is beyond the scope of this paper, but the overbuilding that occurred in low smart growth areas (new subdivisions by home builders) was probably very different than the overbuilding in high smart growth areas (more infill, one-off, speculative investments).

Table V.17: Occupied and Vacant Units

		High Smart Growth				Medium Smart Growth				Low Smart Growth			
		2000	2005/09	Change	% Change	2000	2005/09	Change	% Change	2000	2005/09	Change	% Change
Occupied Units	#	99,439	116,245	16,806	16.9%	199,059	206,543	7,484	3.8%	963,396	1,136,872	173,476	18.0%
	%	89.4%	82.6%	-6.8%		93.2%	84.9%	-8.3%		95.7%	89.3%	-6.4%	
Vacant Units	#	11,759	24,428	12,669	107.7%	14,488	36,709	22,221	153.4%	43,123	136,666	93,543	216.9%
	%	10.6%	17.4%	6.8%		6.8%	15.1%	8.3%		4.3%	10.7%	6.4%	

Tenure

The form of tenure had some of the most dynamic changes by smart growth areas during the 2000s. In 2000, the distribution of owner-occupied versus renter-occupied units had a near identical pattern as the multifamily versus single family distribution (Table V.18). In high smart growth areas, approximately 64.2% of units were renter occupied and 35.8% of units were owner occupied; for medium smart growth areas, approximately 61% were renter occupied and 39% were owner occupied; for low smart growth areas, approximately 27.6% were renter occupied and 72.4% were owner occupied (Table V.18). The new development in Atlanta altered these distributions, especially in high and medium smart growth areas. The number of owner occupied units in high smart growth areas increased by 44.3% compared to rental units increasing by only 1.6%. This tremendous increase in owner-occupied units was led by a combination of new condo projects, new single family construction, and conversions of rental units to owner-occupied units. For medium smart growth tracts, the number of rental units actually decreased by nearly 9,000 units, while owner-occupied units increased by 16,408, or 21.1%. Because there was little construction of multifamily in medium smart growth areas, the owner-occupied increases were led by single family construction and the conversion of rentals to owner occupied. Any growth in rental units that did occur in the metro area was the result of new rental units in low smart growth areas. However, even for renter-occupied housing in low smart growth areas, which increased by 42,000 units, or 15.9%, the percentage of rental housing still declined from 27.6% in 2000 to 27.1% in 2005/09. Across all areas, but especially higher smart growth tracts, development of owner-occupied units fueled increases in housing.

Table V.18: Unit Tenure

		High Smart Growth				Medium Smart Growth				Low Smart Growth			
		2000	2005/09	Change	% Change	2000	2005/09	Change	% Change	2000	2005/09	Change	% Change
Owner-Occupied	#	35,648	51,448	15,800	44.3%	77,727	94,135	16,408	21.1%	697,521	828,792	131,271	18.8%
	%	35.8%	44.3%	8.4%		39.0%	45.6%	6.5%		72.4%	72.9%	0.5%	
Renter-Occupied	#	63,791	64,797	1,006	1.6%	121,332	112,408	(8,924)	-7.4%	265,875	308,080	42,205	15.9%
	%	64.2%	55.7%	-8.4%		61.0%	54.4%	-6.5%		27.6%	27.1%	-0.5%	

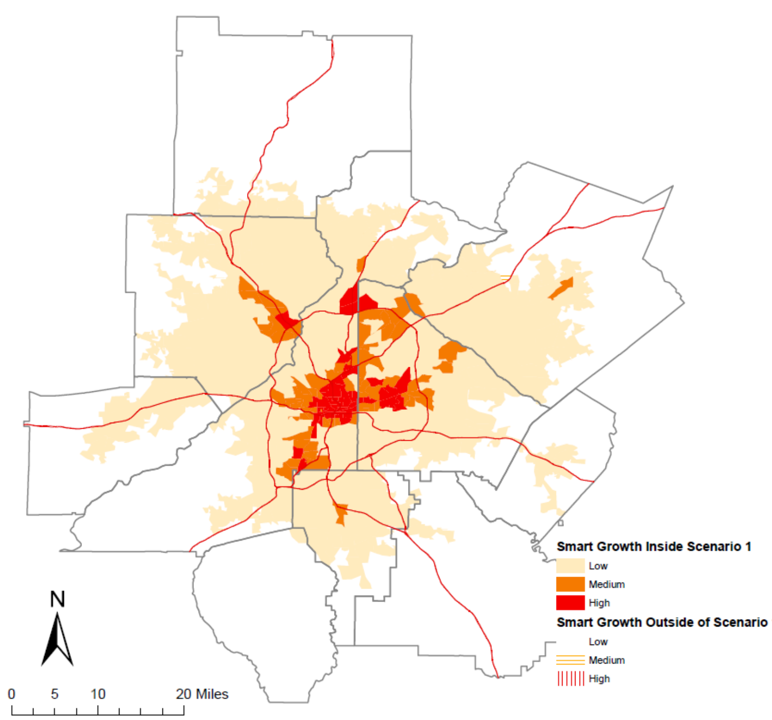
VI. Is Atlanta's infill development smart growth?

This section combines the results of the infill and smart growth boundaries from the preceding two sections to determine if the development that occurred in Atlanta's infill areas during the 2000s was located in areas with smart growth qualities. For each of the four infill scenarios, the discussion is broken into a profile of the infill geographic characteristics of smart growth, the housing characteristics in 2000, as well as the changes in housing for low, medium, and high smart growth areas. Overall, the amount of high smart growth, infill development varies significantly based on which infill scenario is used.

Scenario 1: 1990 Urban Area

Because the 1990 urban boundary encompasses such a large part of the 10 county metro area, it is not a surprise that nearly all of the land is classified as low smart growth with smaller proportions as medium or high smart growth (Map VII.1). Nearly 89 percent of the land, or over 1720 square miles, is low smart growth, 8.4% of the land is medium smart growth, and 2.8% of the land is high smart growth. As mentioned previously, of the four scenarios, only the urbanized area scenario includes areas of all ten counties. Moreover, because of its large size,

Map VI.1 Scenario 1 (Urban Area) and Smart Growth



scenario one is the only scenario that includes all of the medium and high smart growth tracts in the region. Because the urbanized area accounted for so much of the total land area and development, the housing distribution in 2000 was very similar to the metro area average. Low smart growth areas within scenario one had the majority of housing in 2000 with 73.4% of total units, 83.7% of single family units, and 52.1% of multifamily units. Although only a small fraction of the low smart growth areas, housing within the medium and high smart growth areas in the urbanized area boundary were proportionately higher than the metro averages. For example, total units in 2000 was only 8.4% of the entire metro area high smart growth average compared to 9.1% of the high smart growth within the urbanized area. Of course, because no medium or high smart growth areas were located outside of the urbanized area boundary, the actual number of units was the same between the infill scenario and entire metro area.

Table VI.1 Smart Growth within Scenario 1, 1990 Urban Area

Inside of Scenario 1

			2000			2005/09			Change		
SmartGrowth	Acres	# Tracts	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Low	1,101,840	355	898,253	667,844	209,606	1,094,338	827,113	247,559	196,085	159,269	37,953
Medium	104,121	91	213,547	89,240	122,638	243,252	111,489	129,706	29,705	22,249	7,068
High	34,477	69	111,198	41,095	70,027	140,673	52,188	87,684	29,475	11,093	17,657
Total	1,240,437		1,222,998	798,179	402,271	1,478,263	990,790	464,949	255,265	192,611	62,678
			Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Low	88.8%		73.4%	83.7%	52.1%	74.0%	83.5%	53.2%	21.8%	23.8%	18.1%
Medium	8.4%		17.5%	11.2%	30.5%	16.5%	11.3%	27.9%	13.9%	24.9%	5.8%
High	2.8%		9.1%	5.1%	17.4%	9.5%	5.3%	18.9%	26.5%	27.0%	25.2%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	20.9%	24.1%	15.6%

Outside of Scenerio 1

			2000			2005/09			Change		
SmartGrowth	Acres	# Tracts	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Low	692,758	49	108,266	93,580	8,226	179,200	157,716	15,868	70,934	64,136	7,642
Medium	-	-	-	-	-	-	-	-	-	-	-
High	-	-	-	-	-	-	-	-	-	-	-
Total	692,758		108,266	93,580	8,226	179,200	157,716	15,868	70,934	64,136	7,642
			Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Low	100.0%		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	65.5%	68.5%	92.9%
Medium	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
High	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	65.5%	68.5%	92.9%

Whereas regionally, increases in housing units was concentrated in both low and high smart growth areas, within the infill boundary of scenario one, increases were concentrated most in high smart growth areas.   High smart growth infill areas had increases of 26.5% for total units, 27.0% for single family units, and 25.2% for multifamily units, compared to 21.8% increase for low smart growth infill units and 13.9% for medium smart growth infill units (Table VI.1) The reason for this reduction in scenario one's polarization between increases in high smart growth areas and low smart growth areas was due to significant increases in housing units in non-infill low smart growth. In low smart growth areas outside of the boundary, total units increased by over 65%, single family by 68%, and multifamily by 93%. For scenario one, growth in low smart growth areas was led by non-infill locations. Of course, these measures are somewhat misleading given the actual changes in real units: an increase of 196,000 units in low smart growth infill areas compared to 71,000 total units in low smart growth non-infill areas.

Overall, despite the small amount of medium and high smart growth land, infill scenario one had the greatest percentage increases for high smart growth areas. Additionally, despite its inclusion of large amounts of low smart growth areas, the fact that growth rates for low smart growth were higher outside of the boundary indicates that development metro wide favored the most distant locations over infill locations.

Scenario 2: Incorporated areas with housing density greater than 2 units/acre

Scenario 2, the infill areas based on density, is significantly smaller and more concentrated than the urbanized area boundary, and consequently, it has a much lower amount of low smart growth areas and more medium and high growth areas (Map VI.2). Of the approximately 194 square miles of scenario 2, 24% of the land is classified as high smart growth, 35% medium smart growth, and 42% low smart growth (Table VI.2). Of the four scenarios, scenario 2 best aligns with the medium and high smart growth areas with about 85% of all high smart growth land located inside the infill boundary. This is partially the result of the higher weighting of density in the smart growth index. The boundary is less precise for medium growth, but still better than the other scenarios, capturing about 59% of total medium smart growth land in the metro area. This lower capture rate of medium smart growth land is the result of larger parcels of medium smart growth tracts in Gwinnett and DeKalb counties.

Of the total units within the scenario 2 infill boundary in 2000, the distribution between low, medium, and high smart growth areas is close to what is expected. In 2000, there were 377,444 total units within these tracts with about 40% of the units being single family and 60% of the units being multifamily. Despite differences in the amount of land area, the total unit distribution is pretty evenly spread across high, medium, and low smart growth areas with 27%, 37%, and 35% respectively. The spread is, as expected, different for single family and multifamily units. About 42% of single family units are located in low smart growth areas versus 31% of multifamily units. Conversely, high smart growth areas have about 25% of the single family units versus 30% of multifamily units. Somewhat surprising was the high amount of multifamily units located in medium smart growth areas. A possible explanation is that high smart growth scenario 2 infill areas have a much higher percentage of non-residential uses compared to the medium smart growth tracts in this scenario.

Map VI.2 Scenario 2 (HU Density) and Smart Growth

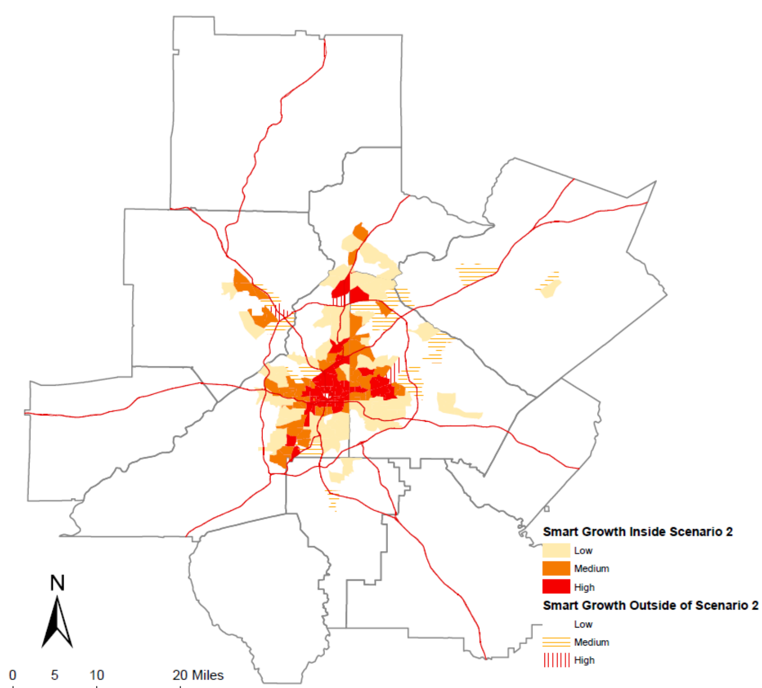


Table VI.2 Smart Growth within Scenario 2, Incorporated Area with HU Density > 2 per acre

Inside Scenario 2

			2000			2005/09			Change		
SmartGrowth	Acres	# Tracts	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Low	51,969	51	133,396	64,090	68,374	142,074	70,893	70,131	8,678	6,803	1,757
Medium	43,002	57	140,195	50,899	88,471	157,398	63,331	92,500	17,203	12,432	4,029
High	29,404	61	103,853	37,983	65,816	130,403	48,721	80,933	26,550	10,738	15,117
Total	124,375		377,444	152,972	222,661	429,875	182,945	243,564	52,431	29,973	20,903
			Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Low	41.8%		35.3%	41.9%	30.7%	33.1%	38.8%	28.8%	6.5%	10.6%	2.6%
Medium	34.6%		37.1%	33.3%	39.7%	36.6%	34.6%	38.0%	12.3%	24.4%	4.6%
High	23.6%		27.5%	24.8%	29.6%	30.3%	26.6%	33.2%	25.6%	28.3%	23.0%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	13.9%	19.6%	9.4%

Outside of Scenerio 2

			2000			2005/09			Change		
	Acres	# Tracts	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Low	1,742,630	353	873,123	697,334	149,458	1,131,464	913,936	193,296	258,341	216,602	43,838
Medium	61,118	34	73,352	38,341	34,167	85,854	48,158	37,206	12,502	9,817	3,039
High	5,072	8	7,345	3,112	4,211	10,270	3,467	6,751	2,925	355	2,540
Total	1,808,820		953,820	738,787	187,836	1,227,588	965,561	237,253	273,768	226,774	49,417
			Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Low	96.3%		91.5%	94.4%	79.6%	92.2%	94.7%	81.5%	29.6%	31.1%	29.3%
Medium	3.4%		7.7%	5.2%	18.2%	7.0%	5.0%	15.7%	17.0%	25.6%	8.9%
High	0.3%		0.8%	0.4%	2.2%	0.8%	0.4%	2.8%	39.8%	11.4%	60.3%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	28.7%	30.7%	26.3%

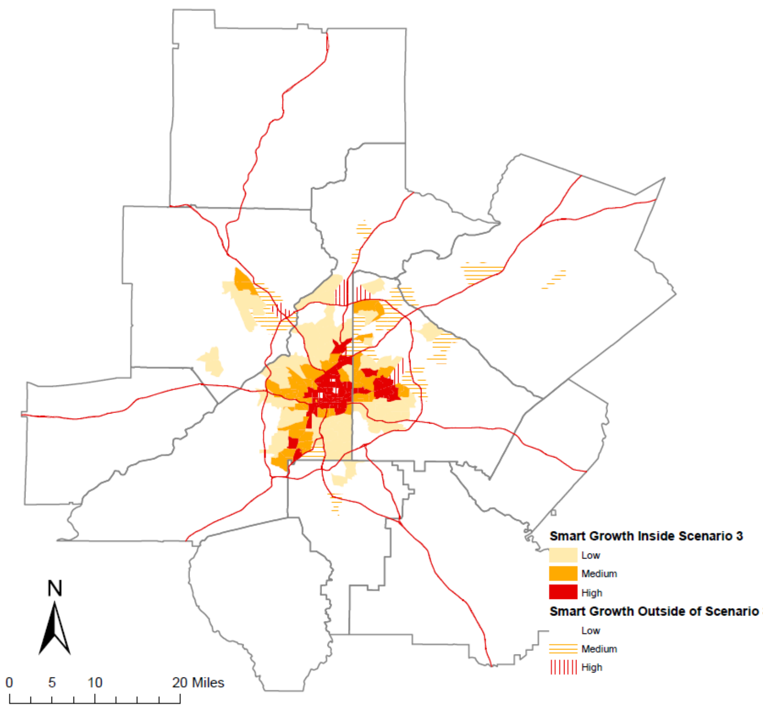
Despite the somewhat even distribution of housing units in 2000 across scenario 2, the scenario 2 infill changes favored, overwhelmingly, the medium and high smart growth areas. Overall, infill scenario 2 had an increase of total units of 13.9%, whereas medium smart growth areas had 12.3% increase and high smart growth areas had 25.6% increase. Although the medium smart growth rate is still lower than the metro average rate, the high smart growth areas changed at rate over one percentage points higher than the metro average (25.6% versus 24.5%). Looking more closely at single family, these trends hold true with both the medium and high smart growth tracts increasing at rates higher than the metro area average. For multifamily, high smart growth tracts increased more greatly than the metro average at 23.0%; however, medium smart growth tracts grew at a much lower rate of 4.6%. A partial explanation for this is the higher starting basis for multifamily units in medium smart growth tracts (see previous paragraph); however, even with this higher basis, only 4,000 new multifamily units were created in medium smart growth tracts versus 15,000 in high smart growth tracts. Although this infill scenario captures a large number of the high smart growth tracts, it does not include some of the greatest changing high smart growth tracts. In fact, the high smart growth tracts outside of scenario 2's boundary have an increase of 39.8% for total units and 60.3% for multifamily units, which are among the highest rates across any of the scenarios.

Overall, infill scenario 2 demonstrates that housing unit increases that occurred in infill areas favored high smart growth locations. First, the infill boundary aligns well with the medium and high smart growth boundary, demonstrating the idea of smart growth being a characteristic of infill. Second, housing unit increases overwhelmingly occurred in the high smart growth infill areas. Of course, many of these conclusions are the result of the smart growth index being weighted by density variables, which is the base for this infill scenario.

Scenario 3: Incorporated areas with average age of housing older than 1975

Although scenario 3, based on age, is roughly the same size as scenario 2, it is not nearly as strong at aligning with the medium and high smart growth areas (Map VI.3). Of the 201 square miles in scenario 3, about 52% are low smart growth, 28% are medium smart growth, and 19% are high smart growth compared to scenario 2's 42%, 35%, and 24%, respectively (Table VI.3). Moreover, whereas 85% of high smart growth and 41% of medium smart growth land was located inside the scenario 2 infill boundary, only 71% of high smart growth land and 35% of medium smart growth land is located within the boundary of scenario 3. Much of these differences can be explained by the low density areas that have older housing, such as near Buckhead, around Marietta in Cobb County, and south of Decatur in DeKalb County. Although these areas are older, they do not have medium and high smart growth attributes. Conversely, large medium and high smart growth areas of Cobb County, which are newer, are not included in infill scenario 3.

Map VI.3 Scenario 3 (Housing Age) and Smart Growth



Although scenario 3 is slightly larger than scenario 2, because of the greater amount of low smart growth areas, the number of total units is much lower. In 2000, about 275,000 units were located within the scenario 3 boundary with about 53% of the units being single family and 47% of the units being multifamily, which is still significantly different than the ratio of two-thirds single family to one-third multifamily at the metro level. The distribution of total housing units and single family units across low, medium, and high smart growth areas follows a similar pattern to both scenario 1 and scenario 2 with high and medium smart growth areas having a disproportionate amount of the units given the land area. Unlike the previous scenarios, though, multifamily has a different breakdown with 37% of the units in high smart growth tracts, 30% in medium smart growth tracts, and 33% of low smart growth tracts. It is surprising that low smart growth tracts have a higher percentage of multifamily than low smart growth tracts in scenario 2. This could be the result of older areas, even lower density areas, having a higher mix of building types with more apartments located next to single family homes.

Table VI.3 Smart Growth within Scenario 3, Incorporated Area with Median Housing Age older than 1975

Inside Scenario 3

			2000			2005/09			Change		
SmartGrowth	Acres	# Tracts	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Low	67,868	56	110,888	68,113	41,865	124,352	77,120	45,886	13,464	9,007	4,021
Medium	36,361	48	82,996	43,509	38,601	100,068	55,423	43,629	17,072	11,914	5,028
High	24,497	60	81,226	34,348	46,837	107,134	44,541	61,860	25,908	10,193	15,023
Total	128,727		275,110	145,970	127,303	331,554	177,084	151,375	56,444	31,114	24,072
			Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Low	52.7%		40.3%	46.7%	32.9%	37.5%	43.5%	30.3%	12.1%	13.2%	9.6%
Medium	28.2%		30.2%	29.8%	30.3%	30.2%	31.3%	28.8%	20.6%	27.4%	13.0%
High	19.0%		29.5%	23.5%	36.8%	32.3%	25.2%	40.9%	31.9%	29.7%	32.1%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	20.5%	21.3%	18.9%

Outside of Scenerio 3

			2000			2005/09			Change		
	Acres	# Tracts	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Low	1,726,730	348	895,631	693,311	175,967	1,149,186	907,709	217,541	253,555	214,398	41,574
Medium	67,759	43	130,551	45,731	84,037	143,184	56,066	86,077	12,633	10,335	2,040
High	9,979	9	29,972	6,747	23,190	33,539	7,647	25,824	3,567	900	2,634
Total	1,804,469		1,056,154	745,789	283,194	1,325,909	971,422	329,442	269,755	225,633	46,248
			Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Low	95.5%		84.8%	93.0%	62.1%	86.7%	93.4%	66.0%	28.3%	30.9%	23.6%
Medium	3.7%		12.4%	6.1%	29.7%	10.8%	5.8%	26.1%	9.7%	22.6%	2.4%
High	0.6%		2.8%	0.9%	8.2%	2.5%	0.8%	7.8%	11.9%	13.3%	11.4%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	25.5%	30.3%	16.3%

Despite the weaknesses of scenario 3 aligning with the high and medium smart growth areas, this infill scenario was strong in capturing the higher growing areas. Compared to the overall growth rates scenario 2, scenario 3 had higher rates of 20.5% for total units, 21.3% for single family units, and 18.9% for multifamily units. Although the total units and single family rates were still below the metro average, the multifamily unit growth was actually above the metro average by almost 2 percentage points. Looking more closely at the changes by smart growth category, high smart growth areas inside scenario 3 boundary had total unit increases of 31.9% compared to 11.9% in high smart growth areas outside the boundary. This trend holds true for both single family units and multifamily units for high smart growth areas, demonstrating the significant amount of infill development in high smart growth areas. Medium smart growth, which for the metro area had much lower growth rates, was considerably higher in scenario 3. In fact, the growth rates of 20.6% for total units, 27.4% for single family, and 13.0% for multifamily were close to the infill scenario averages. These high rates indicate that scenario 3 does a strong job at capturing the medium smart growth areas that had the greatest increases.

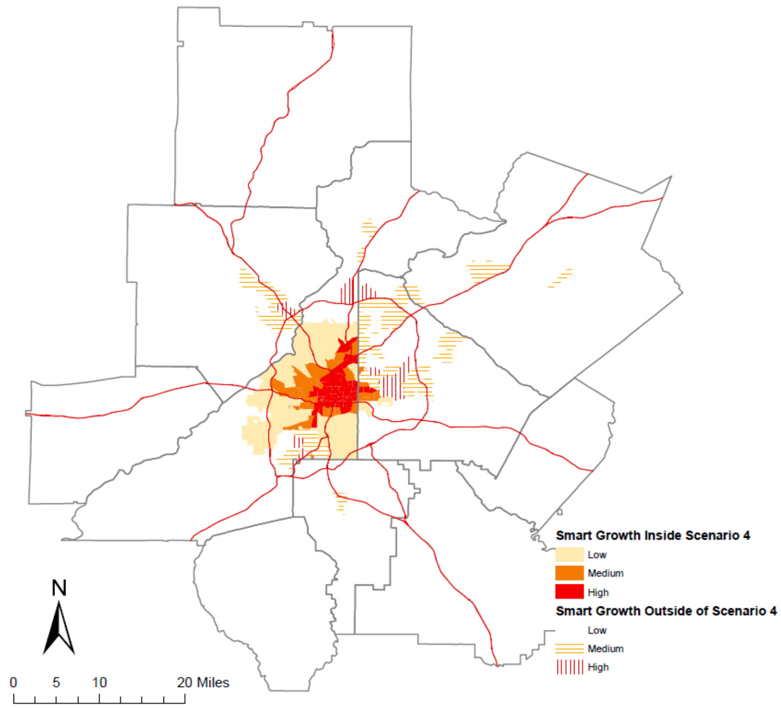
Moreover, for both high and medium smart growth areas, the rates of increases inside the infill scenario were much higher than the rates of growth outside of the boundary. Finally, like scenario 2, scenario 3's low smart growth areas had low growth rates; however, because scenario 3 included a greater variety of low smart growth areas, the changes were higher than scenario 2.

Overall, although scenario 3's boundary does not align as perfectly with the smart growth areas, the medium and high smart growth areas capture areas with much higher growth rates than scenario 2. These rates of growth indicate that growth in high and medium location across the metro area was concentrated in infill locations.

Scenario 4: City of Atlanta Boundary

Scenario 4, the City of Atlanta Boundary, does a poor job of capturing the region's medium and high smart growth areas (Map VI.4). Because a lot of the region's high smart growth areas are located outside of the city limit, this infill boundary does not capture a lot of these areas for the region. In fact, only 53% of the high smart growth land and 26% of the medium smart growth land is located within the city boundary (Table VI.4). Within the city's 193 square miles, the distribution of smart growth land favors low smart growth, which has about 63% of the city's land. Medium and high smart growth land accounts for about 22% and 15% of the land, respectively. This distribution of only 37% of the infill boundary's land being medium or high smart growth is significantly lower than scenario 2 or 3, where medium and high smart growth accounted for 58% and 47% of the scenario's land area, respectively. Medium and high smart growth are concentrated in the center and eastern parts of the city with much of the northern, western, and southern sections of the city having low smart growth land. Whereas the previous two infill scenarios discounted these areas because of density or housing age, the large amounts of low smart growth land demonstrates the arbitrary nature of the city limits in being a strong infill measure in the traditional sense of the term.

Map VI.4 Scenario 4 (City of Atlanta) and Smart Growth



Despite the very different distribution of land in the City of Atlanta boundary scenario that was primarily low smart growth, the unit distribution in 2000 was actually quite even across the three smart growth areas. Low smart growth areas accounted for about 37% of the units, medium smart growth for about 31%, and high smart growth for about 33% of the units. Other than scenario 1, the gap between the amount of land and housing units per smart growth category is the most uneven. The 71,000 units total units in high smart growth areas were located on less than 15% of the total land versus 80,000 units located on about 63% of the total land. A lot of this unevenness can be explained by the large amount of low smart growth tracts that have minimal amounts of residential uses. The high smart growth tracts favors multifamily units, where about 41.6% of the scenario 4 multifamily units are located, nearly two to one. Conversely, low smart growth tracts have nearly 45% of the single family units in scenario 4 and only 29% of the multifamily units.

Table VI. Smart Growth within Scenario 4, City of Atlanta Boundary

Inside Scenario 4

			2000			2005/09			Change		
SmartGrowth	Acres	# Tracts	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Low	78,387	38	79,842	47,211	32,314	99,518	61,697	37,157	19,676	14,486	4,843
Medium	27,108	37	66,388	33,328	32,466	83,261	43,745	38,839	16,873	10,417	6,373
High	18,353	54	71,536	25,384	46,083	98,354	35,300	62,416	26,818	9,916	16,333
Total	123,848		217,766	105,923	110,863	281,133	140,742	138,412	63,367	34,819	27,549
			Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Low	63.3%		36.7%	44.6%	29.1%	35.4%	43.8%	26.8%	24.6%	30.7%	15.0%
Medium	21.9%		30.5%	31.5%	29.3%	29.6%	31.1%	28.1%	25.4%	31.3%	19.6%
High	14.8%		32.8%	24.0%	41.6%	35.0%	25.1%	45.1%	37.5%	39.1%	35.4%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	29.1%	32.9%	24.8%

Outside of Scenerio 2

			2000			2005/09			Change		
	Acres	# Tracts	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Low	1,716,211	366	926,677	714,213	185,518	1,174,020	923,132	226,270	247,343	208,919	40,752
Medium	77,012	54	147,159	55,912	90,172	159,991	67,744	90,867	12,832	11,832	695
High	16,124	15	39,662	15,711	23,944	42,319	16,888	25,268	2,657	1,177	1,324
Total	1,809,348		1,113,498	785,836	299,634	1,376,330	1,007,764	342,405	262,832	221,928	42,771
			Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Low	94.9%		83.2%	90.9%	61.9%	85.3%	91.6%	66.1%	26.7%	29.3%	22.0%
Medium	4.3%		13.2%	7.1%	30.1%	11.6%	6.7%	26.5%	8.7%	21.2%	0.8%
High	0.9%		3.6%	2.0%	8.0%	3.1%	1.7%	7.4%	6.7%	7.5%	5.5%
Total			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	23.6%	28.2%	14.3%

Changes in housing units, across all smart growth levels in the City of Atlanta, were very high. The high smart growth areas changes were the highest with total unit increases of 38%, 39% for single family, and 35% or multifamily. This scenario was the most effective in capturing the high smart growth areas with the largest increases, as high smart growth areas outside the City of Atlanta only increased by 6.7% total units, 7.5% multifamily units, and 5.5% single family units. The medium and low smart growth areas also had strong increases, though not as much as the high smart growth areas. Medium smart growth areas within the boundary had much higher growth rates than the other scenarios. Moreover, like the high smart growth areas, the boundary effectively captured the largest increasing medium smart growth areas. Low smart growth areas within the boundary were not much different than outside the boundary. In these low smart growth areas, total units inside increased by 24.6% versus 26.7% outside; single family units increased by 30.7% versus 29.3% outside; and multifamily units increased by only 15% inside the boundary versus 22% outside the boundary.

Overall, despite the large amounts of low smart growth areas in the boundary, the medium and high smart growth areas within the City of Atlanta had very large increases in the number of units.

VII. Conclusion

The goal of this paper has been to break apart the often muddied concepts of infill and smart growth and treat them as two separate, yet related, ideas. To this end, four different infill scenarios for metro Atlanta were selected based on different methodologies used by academics and practitioners who work to understand infill. Then, areas across the entire metro area were scored for the presence of smart growth characteristics. The attributes of infill and the attributes of smart growth were treated separately throughout much of the process. The infill and smart growth approaches were then overlaid to the increases of housing units in smart growth areas within the boundaries of the four infill scenarios.

Methodologies

The four different infill scenarios provide very different definitions of infill development in metro Atlanta. Although Scenario 1, the urbanized area, provides a boundary that is much more comprehensive than most definitions of infill, in other metro areas that are slower growing or more compact, this methodology could be more accurate. Scenario 2 and 3, based on density and housing age, provide more accurate boundaries of infill locations for metro Atlanta. Density, as used in Scenario 2, is the more common method in academic and practitioner literature for measuring infill; however, the methodology captures more traditional high smart growth infill areas, but not the low smart growth infill areas that are so prevalent in Atlanta. Although average housing age, as used in Scenario 3, has not been as widely used, given that neighborhoods tend to develop at around the same time, this provides a conceptually strong method of capturing areas that are already built out. While this study begins to think about the use of average housing age, more work needs to be done in determining a cut off age and possibly linking the median age to other variables to capture an area's housing homogeneity and if the area is built out. Finally, relying on the metro area's central city boundary, as demonstrated by recent infill studies and this study provides a weak definition of an infill area. Although the concept of infill began with new development in central cities, this definition is no longer enough as more housing develops in areas that are neither the central city nor greenfields.

Although these four different scenarios were developed from established methodologies, in the future, some type of infill index based on variables—similar to the smart growth index used in this paper—could be developed. Because these scenarios do not look at how much of an area is built out, some type of variable for percent of land built out could be included. Additionally, when not using already established boundaries (Scenario 1 and 4), this study relies only on housing data; however, with the redevelopment of existing industrial and commercial areas to mixed use or residential, other variables need to be included. Additionally, different forms of infill could be defined, such as urban, first generation suburbs, older town centers, or industrial, and different variables and characteristics could be included for each form. Regardless of how infill is measured in the future, it is crucial that infill is first defined, ensuring the definition is not limited to areas with high smart growth characteristics, and then a methodology can be developed to be measure this definition.

When developing the smart growth index, a number of lessons emerged. While the index provides a simple method to capture the presence of smart growth, by limiting classifications to high, medium, and low, the method is inherently reductive and does not capture the nuance of urban form. The lack of nuance is worsened by the use of the Census Tract. Although some type of counting area is used in most smart growth research, the Census tract is too big to be used as an effective counting area. Using a block group or a raster method would provide researchers a more accurate reflection of local smart growth characteristics. These alternative approaches, however, would be much more complicated to find data and perform analysis. Although the goal of this paper is to holistically capture the presence smart growth, much of the smart growth literature this paper's variables are based on define smart growth through a focused lens, such as urban design, transportation, or environment. A smart growth index needs to carefully reconcile the variables used from these disparate methods. Finally, this index does not test for statistical significance of variables or correlation between variables, which is beyond the scope of this study, but could be useful in narrowing down to the most important variables.

Beyond the methodologies of capturing the counting areas for smart growth and infill, it is important to recognize what this study does and does not measure. The analysis of development patterns found in this paper is based only on new housing units. It does not measure investment in existing housing (remodeling or teardowns), reduction in vacancies, population increases, or changes in home prices. In a time of fast growth led by new construction, analysis of new units provides a reasonable indicator to capture changes in infill and smart growth. When growth is slower, as it is currently, other variables, such as vacancies, building permits, or populations should be used to analyze the change in patterns of infill and smart growth. Additionally, this study is based only on total, single family, and multifamily units, which provides simplicity for analysis, but does not capture the different types of multifamily housing. Are these duplexes being developed, buildings with hundreds of units, or something in between? More details would present a different picture of how development is occurring. Above all, this study relies on the U.S. Census American Community Survey 2005/09 data, which is based on an estimate. For this project, the estimate is fine, but for a more detailed study, more precise data would be appropriate.

Results

The perceptions of Atlanta as a low density, suburban metropolis hold true. With the exception of Infill Scenario 1, areas that could be considered infill account for less than seven percent of total land in the other three scenarios. Similarly, less than 8 percent of the land is classified as high or medium smart growth. Additionally, these estimates are among the highest percentages for the metro area. In this study, only the metro area's ten core counties are included that equal less than half of Atlanta Regional Commission boundary or the official Metropolitan Statistical Area. If these areas were included, there would be an even lower percentage of infill and smart growth areas.

Growth generally favored non-infill locations in the metro area between 2000 and 2005/09. For Scenarios 1, 2 and, 3, growth, on a percentage basis, was greater outside of the boundary. This difference was most significant for Scenario 1, where growth rates outside of the boundary were over 60%, indicating the rapid growth of the outer-most suburbs in the metro area. In all infill scenarios, single family growth rates exceeded multifamily rates, further indicating the preference for single family housing across metro Atlanta. In Scenario 2, for instance, single family increased by 21%, whereas multifamily increased by only 9%. Only for the City of Atlanta Boundary did growth within the boundary exceed growth outside of the boundary.

When looking at the patterns of housing unit increases in smart growth areas, a number of trends emerged. First, growth in the metro area was bifurcated between low and high smart growth areas, with much less development occurring in medium smart growth areas. It is unclear why these medium smart growth areas did not experience more growth, but it could be explained these areas being more built out and more restrictive zoning that constrain higher intensity redevelopment. Another trend in high and medium smart growth areas was the rapid shift from renter to owner-occupied units. This trend can be seen by the large number of new condominium projects and the conversions of buildings from rental to ownership throughout these smart growth areas. While the emphasis towards homeownership was well documented nationally, it would be interesting to compare Atlanta's experience in condo development versus rental apartment development to the experience in high smart growth areas of other metro areas. Additionally, it will be interesting to see how new housing development in these same areas will be different with the renewed interest in apartment housing.

When combining the smart growth and infill scenarios, very different trends emerge. Based on what infill scenario is selected, and to a lesser extent the calculation of the smart growth, wildly different conclusions can be extrapolated about the types and locations of infill development in the metro area. If an argument wants to be made that infill and smart growth are more or less the same, infill scenario 2, based on housing unit density, should be selected because it captures nearly all of the metro area's medium and high smart growth area. However, in capturing much of the medium and high smart growth areas, this scenario accounted for smaller overall growth rates of housing in medium and high smart growth areas. If an argument wants to be made about infill being associated with high rates of growth, scenario 3 based on median housing unit age or scenario 4 based on the city's boundary should be used. Although these scenarios do not include many of the region's medium and smart growth areas, the changes in housing units were much larger in these two scenarios. A lot of these large changes in these infill scenarios, however, were the result of single family development in low smart growth areas.

As urban development patterns change in the coming decades, ideas related to infill and smart growth will only increase in importance. These development patterns that challenge urban growth based on endless outward expansion will radically change how the private and public sectors understand and approach development. The private sector will face the challenge of building in a complicated, inconsistent environment, while the public sector will need to better plan for and facilitate development that will radically affect citizens, the environment, and the local economy. In order to plan for this infill development and smart growth, especially in newer metro areas like Atlanta, a more rigorous approach is necessary to think and evaluate development trends at a regional scale.

Works Cited

Bagley, Michael N., Patrica L. Mokhtarian, and Ryuichi Kitamura. 2002. "A Methodology for the Disaggregate, Multidemensional Measurement of Residential Neighborhood Type." *Urban Studies* 39 (4): 689-704.

Cervero, Robert, and Kara Kockelman. 1997. "Travel Demand and the 3Ds, Density, Diversity, and Design." *Transportation Research Part D: Transport and Environment* 2 (3) (September). http://trid.trb.org/view.aspx?id=576689.

Charles, Suzanne L. 2011. "Suburban Gentrification: Understanding the Determinants of Single-family Residential Redevelopment, A Case Study of the Inner-Ring Suburbs of Chicago, IL, 2000-2010." *Joint Center for Housing Studies Harvard University*.

Clifton, Kelly, Reid Ewing, Gerrit-Jan Knaap, and Yan Song. 2008. "Quantitative analysis of urban form: a multidisciplinary review." *Journal of Urbanism: International Research on Placemaking and Urban Sustainability* 1 (March): 17-45. doi:10.1080/17549170801903496.

Department of Commerce, and Census Bureau. 2011. "Urban Area Criteria for the 2010 Census; Notice." *Federal Register* 76 (164) (August 24): 53030–53042. doi:110714393-1393-01.

Danielsen, Karen A., Robert E. Lang, and William Fulton. 1999. "Retracting suburbia: Smart growth and the future of housing." *Housing Policy Debate* 10 (January): 513-540. doi:10.1080/10511482.1999.9521341.

Downs, Anthony. 2005. "Smart Growth: Why We Discuss It More than We Do It." *Journal of the American Planning Association* 71 (December 31): 367-378. doi:10.1080/01944360508976707.

Dye, Richard F., and Daniel P. McMillen. 2007. "Teardowns and land values in the Chicago metropolitan area." *Journal of Urban Economics* 61 (1): 45–63.

Farris, J. Terrence. 2001. "The barriers to using urban infill development to achieve smart growth." *Housing Policy Debate* 12 (January): 1-30. doi:10.1080/10511482.2001.9521395.

Fleissig, Will, and Vickie Jacobsen. 2002. *Smart scorecard for development projects*. Supported by The Congress for New Urbanism and U.S. EPA. January.

Galster, George, Royce Hanson, Michael R. Ratcliffe, Harold Wolman, Stephen Coleman, and Jason Freihage. 2001. "Wrestling Sprawl to the Ground: Defining and measuring an elusive concept." *Housing Policy Debate* 12 (January): 681-717. doi:10.1080/10511482.2001.9521426.

Haughey, Richard. 2001. *Urban Infill Housing: Myth and Fact*. Washington D.C.: ULI-the Urban Land Institute. http://www.uli.org/ResearchAndPublications/Reports/~/media/Documents/ResearchAndPublications/Reports/Affordable%20Housing/Urban%20Infill.ashx.

Krizek, Kevin J. 2003. "Residential Relocation and Changes in Urban Travel: Does Neighborhood-Scale Urban Form Matter?" *Journal of the American Planning Association* 69 (September 30): 265–281. doi:10.1080/01944360308978019.

Landis, John D., Heather Hood, Guangyu Li, Thomas Rogers, and Charles Warren. 2006. "The future of infill housing in California: Opportunities, potential, and feasibility." *Housing Policy Debate* 17 (January): 681-725. doi:10.1080/10511482.2006.9521587.

Lee, Sugie, and Nancey Green Leigh. 2005. "The Role of Inner Ring Suburbs in Metropolitan Smart Growth Strategies." *Journal of Planning Literature* 19 (3) (February 1): 330 -346. doi:10.1177/0885412204271878.

Listokin, David, Carole Walker, Reid Ewing, Matt Cuddy, and Alan Cander. 2006. *Infill Development Standards and Policy Guide*. New Brunswick, NJ: Center for Urban Policy Research Edward J Bloustein School of Planning & Public Policy, June.

McConnell, Virginia, and Keith Wiley. 2010. *Infill Development: Perspectives and Evidence from Economics and Planning*. Discussion Paper. Washington D.C.: Resources for the Future.

Metro Council. 2009a. *Appendix 9: Residential "economic refill" study: 2001 to 2006*. 2009 - 2030 urban growth report. Portland, OR. http://library.oregonmetro.gov/files/appendix_6_residential_capacity_method.pdf.

———. 2009b. *Appendix 6: Residential Capacity Methodology*. 2009 - 2030 urban growth report. Portland, OR. http://library.oregonmetro.gov/files/appendix_6_residential_capacity_method.pdf.

Miles, Rebecca, and Yan Song. 2009. "'Good' Neighborhoods in Portland, Oregon: Focus on Both Social and Physical Environments." *Journal of Urban Affairs* 31 (4) (October 1): 491–509. doi:10.1111/j.1467-9906.2009.00457.x.

Nelson, Arthur C. 2001. Smart growth or business-as-usual? Contrasting outcomes of different approaches to managing growth. In New Orleans, LA, March 10.

O'Neill, David. 2000. *Smart Growth Tool Kit*. Urban Land Institute, February 1.

People for Open Space. 1983. *Room enough: housing and open space in the Bay Area*. San Franisco: Greenbelt Program of the People for Open Space.

Richmond, Henry R. 2000. *Metropolitan land-use reform: The promise and challenge of majority consensus*. Reflections on regionalism. Washington D.C.: Brookings Institution.

Rosenthal, Stuart S., and Robert W. Helsley. 1994. "Redevelopment and the Urban Land Price Gradient." *Journal of Urban Economics* 35 (2) (March): 182-200. doi:10.1006/juec.1994.1012.

Sandoval, Juan, and John Landis. 2000. *Estimating the housing infill capacity of the Bay Area*. Woring Paper Series. Berkeley, CA: Institute of Urban and Regional Development.

Smart Growth America. 2003. Introduction to smart growth. www.smartgrowthamerica.com.

———. 2011. What is "smart growth?" http://www.smartgrowthamerica.org/what-is-smart-growth.

Song, Yan. 2005. "Smart Growth and Urban Development Pattern: A Comparative Study." *International Regional Science Review* 28 (2) (April 1): 239 -265. doi:10.1177/0160017604273854.

Song, Yan, and Gerrit-Jan Knaap. 2007. "Quantitative Classification of Neighbourhoods: The Neighbourhoods of New Single-family Homes in the Portland Metropolitan Area." *Journal of Urban Design* 12 (February): 1-24. doi:10.1080/13574800601072640.

Steinacker, Annette. 2003. "Infill Development And Affordable Housing." *Urban Affairs Review* 38 (4) (March 1): 492 -509. doi:10.1177/1078087402250357.

Talen, Emily. 2003. "Measuring Urbanism: Issues in Smart Growth Research." *Journal of Urban Design* 8 (October): 195-215. doi:10.1080/1357480032000155141.

U.S. Census. 1995. "Urban and Rural Definitions." http://www.census.gov/geo/www/ua/urdef.txt.

Vermont Forum on Sprawl. 2003. Learn about sprawl/smart growth. http://www. vtsprawl.org/Learnabout/smartgrowth/smartgrowthmain.htm.

Wiley, Keith. 2007. An Exploration of Suburban Infill. In College Park, MD: Resources for the Future. http://www.rff.org/rff/events/upload/30215_1.pdf.

Appendix 1: Summary of Infill Studies

Author	Title	Year	Infill Study Area	Capacity or Developed?	New Development?	New Development Assumption	Redevelopment?	Redevelopment Assumption?	Data Type	Data Source	Finding
Sandoval and Landis	Estimating the housing infill capacity of the Bay Area	2000	Urban areas within 9 County San Francisco Region	Capacity	Yes	Vacant parcels that are not in floodplain, have slope less than 15%, not adjacent to Superfund sites, not previously used by heavy industry, not public/institutional use, not condominium.	Yes	Building value=90% Land Value	Tax Assessment	Association of Bay Area Governments	Infill capacity between 500-700 thousand units
Farris	The barriers to using urban infill development to achieve smart growth	2001	Central cities of 22 MSAs	Developed	Yes	Construction Permit	No		New Housing Permit	U.S. Census	Infill housing not happening; inner cities have 29% of housing, but only 5% of new construction
Steinacker	Infill Development and Affordable Housing	2003	Central cities of 68 MSAs	Developed	Yes	Construction Permit	No		New Housing Permit	U.S. Census; HUD	When controlling for land size, cities are building fair share of housing
Landis et al.	The future of Infill housing in California: Opportunties, potential, and feasibility	2006	3 different scenerios based on combination of block density and jurisdictions boundaries	Capacity	Yes	Vacant parcels that are not not public land, not owned by conservancies and have slopes less than 25%	Yes	Improvement-value-to-land value less than .5 for SF properties, less than 1.0 for Commrecial/MF	Tax Assessment	First American Real Estate Solutions	Between 2 and 4 million units
Dye and McMillen	Teardowns and land values in Chicago	2006	Chicago metropolitan area	Developed	No		Yes	Demolition of existing single family house with probit model for missclassifaction; Also, estimate from census (51)	Demolition permit; Tax Assessor; U.S. Census building age data	Chicago Assessment Office; U.S. Census	Over 13,000 "teardowns" from 1993 to 2003 (then used this info to develop a predictive model)
Wiley	An Exploration of Suburban Infill	2007	Devleoped areas in Montgomery County MD (land within beltways, incorporated municipalities, areas developed after 1997 with 2.0 housing units per acre)	Developed	Yes	County Tax Records	No		Tax Assessment	Maryland Property View	80% of development has been infill
Metro Council	Appendix 9: Residential "economic refill" sutdy: 2001 to 2006	2009	Portland metropolitan area	Developed	Yes	Vacant parcel: never had a building; Infill parcel: Previously classified as developed, now no site (primarily from subdivision)	Yes	Demolishing an existing structure to build a new one.	Regional land Information Database (to determine vacancy, infill, redevelopment classification); New Construction permit	Regional Land Information System (RLIS); Construction Monitor	Introduce idea of refill rate
Metro Council	Appendix 6: Residential Capacity Analysis	2009	Portland metropolitan area	Capacity	Yes	Vacant Parcels with deductions for enviornemtnal considerations, setasides for other uses and the addition of zoning	No		Regional land information database for vacancy	Regional Land Information System (RLIS);	92000 potential units
Charles	Suburban Gentrification	2011	Cook County, Non Chicago (128 inner ring suburbs and unincoprorated areas	Develoepd	No		Yes	Demolition permit, and an increase of SF between 1997 and 2010	Demolition permit; Tax Assessor	Cook County Assessor's Foffice	3924 of 560,310 single family parcels redeveloped between 2000 and 2010

Appendix 2: Methodology, Results, Discussion for Each Smart Growth Variable

Housing Unit Density in Developed Areas

Methodology: The methodology to measure residential density in this paper is a combines many of the previous approaches. First, total housing units in 2000—rather than population or single family housing units—was used to measure the existing buildings. Population was not used because of any variation persons per household across Census tracts could skew the results. Also, in areas with population declines, there are a higher percentage of vacant units that still should be counted in a measure of smart growth. Total housing units was used to capture both the single family and multifamily in a tract. Limiting the analysis to single family would cause many of the tracts that have dense multifamily units to not be included. Second, the density calculation was limited to developed residential land area in a tract based on Atlanta Regional Commission's 2001 LandPro GIS data. In older, built out tracts, the developed residential land was practically the same as the whole tract area. For larger tracts with limited development, or tracts that have significant commercial or industrial development, limiting the calculation area to developed residential land ensured that comparisons of density could be made be made among all 564 tracts. Once the total housing units per tract were found and the developed residential area was calculated, the actual calculation was simple division.

These housing unit densities by tract were then grouped into five categories. Below 4 units per acre was the minimum threshold because at densities below 4 units per acre, other smart growth characteristics would be difficult to achieve. Greater than 25 units per acre was set as the maximum threshold because it was the minimum density provided in MARTA transit-oriented development guidelines (see next section). Because of this very high density, the majority of units would be in multifamily buildings. In between this minimum and maximum threshold, three categories were selected: 4 to 10 units/acre; 10 to15 units/acre; and 15 to 25 units/acre. Based on these densities, the housing in these categories is a mix of single family and multifamily units.

Results:

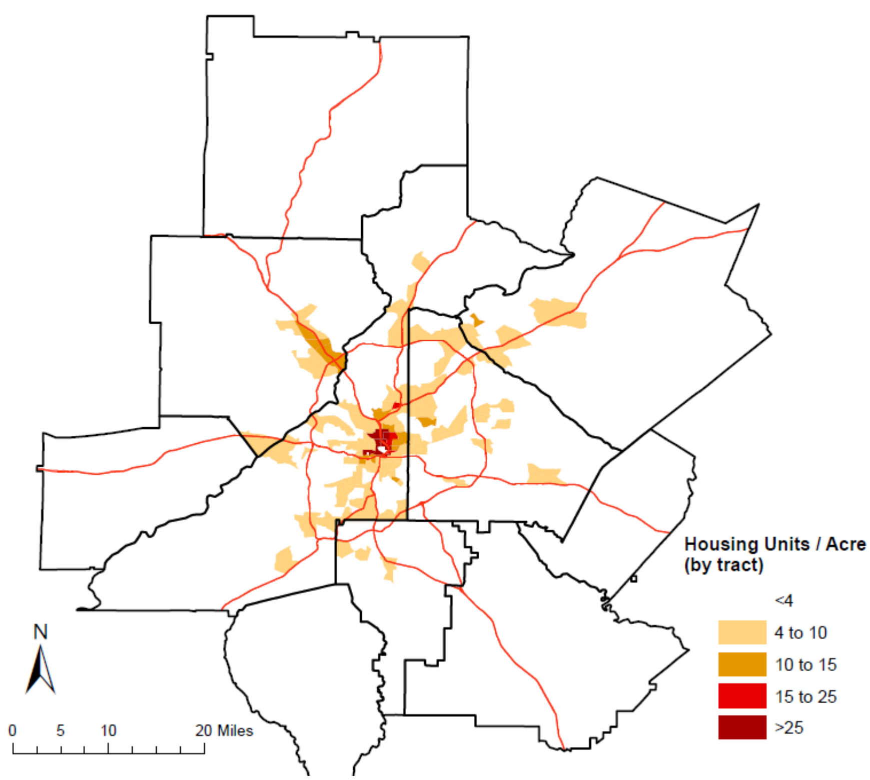
Table V.1: Housing Unit Density

HU Density	Acres	2000			2005/09			Change		
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
<4	1,814,200	1,014,721	790,984	196,763	1,289,926	1,022,675	242,671	275,205	231,691	45,908
4 to 10	106,523	260,724	93,363	165,226	296,707	115,156	178,534	35,983	21,793	13,308
10 to 15	8,971	35,315	5,336	30,126	42,251	7,143	34,765	6,936	1,807	4,639
15 to 25	1,138	8,631	1,075	7,525	10,263	1,782	8,370	1,632	707	845
>25	2,364	11,873	1,001	10,857	18,316	1,750	16,477	6,443	749	5,620
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
<4	93.8%	76.2%	88.7%	47.9%	77.8%	89.0%	50.5%	27.1%	29.3%	23.3%
4 to 10	5.5%	19.6%	10.5%	40.3%	17.9%	10.0%	37.1%	13.8%	23.3%	8.1%
10 to 15	0.5%	2.7%	0.6%	7.3%	2.5%	0.6%	7.2%	19.6%	33.9%	15.4%
15 to 25	0.1%	0.6%	0.1%	1.8%	0.6%	0.2%	1.7%	18.9%	65.8%	11.2%
>25	0.1%	0.9%	0.1%	2.6%	1.1%	0.2%	3.4%	54.3%	74.8%	51.8%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

The geographic patterns of housing unit density and growth had few surprises. Overall, the density was highest in the core of Atlanta, especially in the downtown and midtown neighborhoods (Map V.1). These tracts with more than 15 units per acre make up less than .2% of the total metro area's land in 2000, but had 1.7%, or about 20,000 housing units (Table V.1). Not surprisingly, about 90% of these tracts housing units were multifamily. Growth, among both single family and multifamily units, was very significant in these high density tracts. Overall, the number of units increased by 39% in tracts with greater than 15 units per acre, which is much higher than the metro area average of 24.6%. Surprisingly, single family growth had a 70.1% increase, whereas multifamily growth increased only 35.2%; however, the percentage terms are somewhat misleading due to the low base (only 2,076 initial single family units compared to 18,382 multifamily units).

Looking more closely, in tracts with density greater than 25 units per acre, multifamily units increased by 5,620, or 51.8%, whereas in tracts with density between 15 and 25 units per acre, multifamily increased by only 845 units, or 11.2%. In Atlanta, dense development occurs where dense development already exists, which is a good feature of smart growth.

Map1 Housing Unit Density



Density, especially the 4 to 10 and 10 to15 units per acre tracts spread out primarily along the interstates with a second high concentration in Cobb County at the I-75/I-285 interchange. This pattern makes sense given that multifamily zoning that supports apartment complexes is often located near highways and other major roads. Overall, despite making up only 6% of the total land, close to 48% of the metro areas multifamily units in 2000 are located in the medium density, 4 to 15 units per acre tracts, compared to 11% of single family housing. The growth in these medium density tracts, however, was less than the highest density tracts and the much lower density tracts with only a 14% increase. Single family units outperformed multifamily units, at 24.6% versus 9%, but they were still less than the metro average of 28.8%. This lower growth in medium density tracts demonstrates the recent bifurcation in Atlanta between high density and low density.

Finally, Atlanta's low density tracts saw the vast majority of growth in real terms and in percentage terms. Low density tracts with less than 4 units per an acre made up nearly 94% of total land in 2000 and had about 76% of total units, 89% of single family units, and even 48% of multifamily units. These tracts outperformed the overall average with growth rates of 27.1% for total units, 29.3% of single family units, and 23.3% of single family units (Table V. 1). With this significant growth of an estimated 275,000 new units, the distribution of total housing became more concentrated in these low density tracts, increasing overall by 1.4% from 76.4% to 78%. Although the high density growth is significant, Atlanta remains a low density metro area.

Discussion:

Because density is so critical to smart growth, it is a concept that has not only its own variable, but is also measured more subtly by other variables in this index, including Marta TOD, Street Length, and LCI. A fuller density measure would have incorporated more population and demographic elements, as well as broken out the different types of housing units by both size and by tenure (rental or ownership). Density by age cohort, density and children, and density and income would have provided other insights that may or may not have been useful in an index. The density of rental versus owned, and the density of vacancies, would also provide additional measures that could be used in an index.

Marta TOD

Methodology: Although the MARTA TOD guidelines have multiple requirements for classifying TODs (FAR, height, and residential density), this paper classified tracts based only on residential density. Using the results from the housing unit density calculation (previous section), each tract was coded as four different TODs. Because of the cut offs used in the density section were the same as the cut offs here, the results for high density tracts previously are the same as the TOD classifications.

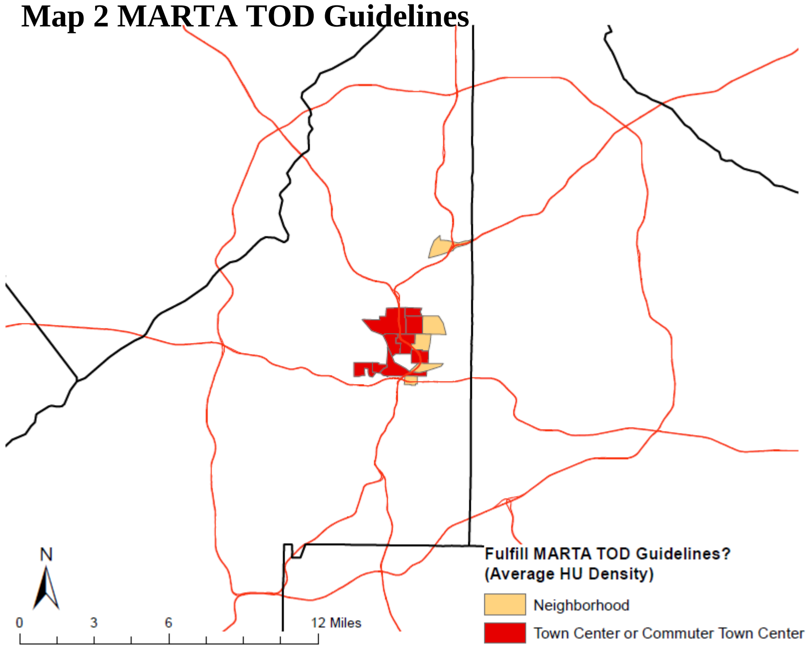
Results:

Table V.2: MARTA TOD Guidelines

		2000			2005/09			Change		
MARTA TOD	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Town Center or Commuter Town Center	2,364	11,873	1,001	10,857	18,316	1,750	16,477	6,443	749	5,620
Neighborhood	1,138	8,631	1,075	7,525	10,263	1,782	8,370	1,632	707	845
Non TOD	1,929,694	1,310,760	889,683	392,115	1,628,884	1,144,974	455,970	318,124	255,291	63,855
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Town Center or Commuter Town Center	0.1%	0.9%	0.1%	2.6%	1.1%	0.2%	3.4%	54.3%	74.8%	51.8%
Neighborhood	0.1%	0.6%	0.1%	1.8%	0.6%	0.2%	1.7%	18.9%	65.8%	11.2%
Non TOD	99.8%	98.5%	99.8%	95.5%	98.3%	99.7%	94.8%	24.3%	28.7%	16.3%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

Only 14 tracts of the 564 were classified for transit oriented development accounting for less than .2% of the total land. These tracts were primarily in the downtown and midtown neighborhoods with one tract near the GA-400 and I-85 interchange (Map V.2). Of these, about two-thirds of the land was classified as a Town Center or Commuter Town Center and one-third classified as neighborhood (Table V.2). Despite making up two-thirds of the land, Town Centers had less than 60% of the housing units in 2000, whereas neighborhoods had 40% of housing units in year 2000. Over 91% of the Town Center units were multifamily in 2000 compared to 87% of neighborhood units.

Map 2 MARTA TOD Guidelines



These TOD tracts had tremendous growth in the total number of single family and multifamily units. Because the tracts were the same as the high-growth tracts in the previous scenario, the changes are the same. There was a 39% increase in total units, 70% increase in single family units, and 35% increase in multifamily. This compares to the 550 non-TOD tracts having an overall growth rate of 24.3%, 28.7% for single family units, and 16.2% for multifamily units. These large overall increases reflected the new multifamily condo buildings in the Midtown tracts.

<u>Discussion:</u>

The TOD guideline variable has a few characteristics worth discussing. Although this TOD classification variable highlights the tracts suitable for TOD development, because this variable is derived from housing unit density, it measures many of the same tracts as this other variable. However, because the classification is based only on tracts with greater than 15 units per acre (high density tracts), this variable does not include the medium-density tracts. Therefore, in the smart growth index, this TOD variable has the effect of weighing the highest density tracts more heavily.

More generally, the methodology of applying the classification based on tract level characteristics has a number of problems. The TOD guidelines are more ideal for studying characteristics of buildings by block or maybe block groups. Because of the relatively small area where TOD can occur (typically within walking distance of a fixed-rail station), tracts—even the smaller ones in more core areas—are too large. For a more effective approach to measuring the presence of TOD, housing unit density should be taken at a smaller level. A similar solution would be to calculate the densities within a certain distance of a transit station. For an even more detailed and nuanced TOD analysis, a survey and classification of the actual buildings characteristics near a transit station could be completed. Because this variable is based only on density, it does not even include the presence of transit. To be stronger, a TOD variable should be for a smaller area with transit present.

Mean Travel Time

<u>Methodology:</u> Although transportation research tends to test travel as a dependent variable, this index is using these studies' results to make travel an independent variable of smart growth. There are many different possible variables from transportation research that measure travel elements such as the number of trips, the length of trip segments, the total distance traveled, and travel time. These detailed travel data, however, are beyond the scope of this smart growth index. Moreover, these measures are typically collected for transportation research at the transportation analysis zone geography that does not align well with Census tracts. For these reasons of level of detail and geographic scope, this index uses the simpler average commuting time as a proxy for travel. Few studies explicitly use travel time as a variable in indexes; however, for this index based on measuring at the tract level, mean commute time is a fair proxy for travel. The underlying rationale for the use of mean travel time is that lower travel time is associated with higher smart growth.

The mean travel time is based on the 2000 Decennial Census. It was organized around five different times. Below 24 minutes is the lowest threshold and represents the highest correlation to smart growth. Greater than 39 minutes is the highest threshold and represents the lowest level of smart growth. Three additional intervals of four to five minutes were selected to categorize the travel times (24 to 29 minutes; 29 to 33 minutes; and 33 to 39 minutes). These different travel times were first developed through natural jenks, and then organized to have more equal distributions.

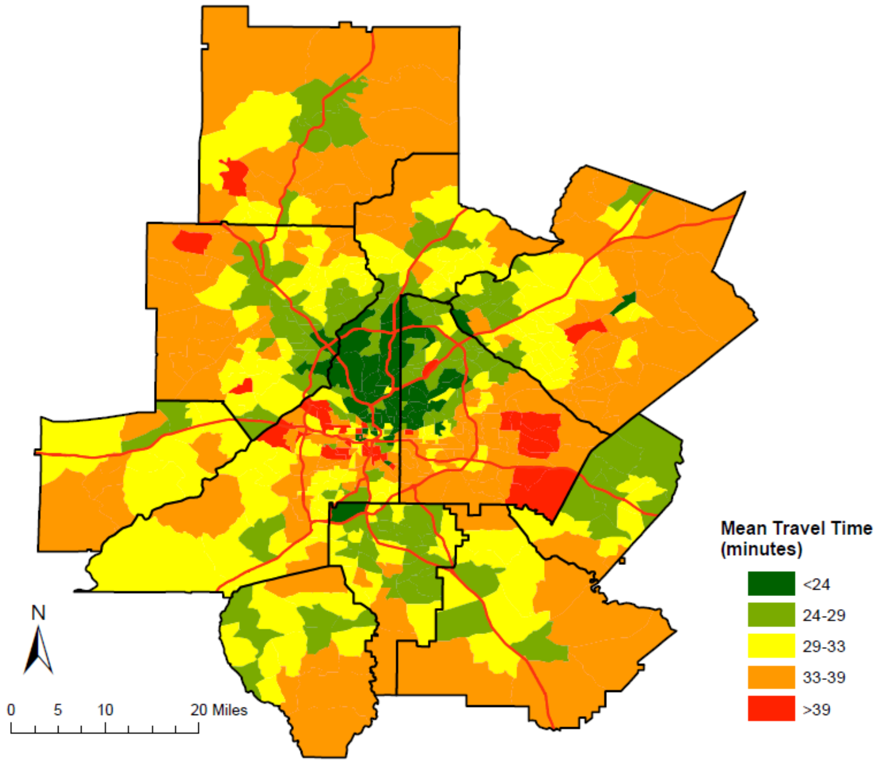
<u>Results:</u>

Table V.3: Mean Commute Time

		2000			2005/09			Change		
Mean Travel Time	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
<24	68,405	145,385	61,226	83,888	183,641	78,488	104,528	38,256	17,262	20,640
24 to 29	282,656	295,617	164,998	124,459	340,342	198,332	135,669	44,725	33,334	11,210
29 to 33	560,690	400,133	283,024	106,643	482,236	348,007	124,957	82,103	64,983	18,314
33 to 39	957,229	424,108	336,101	76,230	568,673	464,023	93,700	144,565	127,922	17,470
>39	64,217	66,021	46,410	19,277	82,571	59,656	21,963	16,550	13,246	2,686
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
<24	3.5%	10.9%	6.9%	20.4%	11.1%	6.8%	21.7%	26.3%	28.2%	24.6%
24 to 29	14.6%	22.2%	18.5%	30.3%	20.5%	17.3%	28.2%	15.1%	20.2%	9.0%
29 to 33	29.0%	30.1%	31.7%	26.0%	29.1%	30.3%	26.0%	20.5%	23.0%	17.2%
33 to 39	49.5%	31.9%	37.7%	18.6%	34.3%	40.4%	19.5%	34.1%	38.1%	22.9%
>39	3.3%	5.0%	5.2%	4.7%	5.0%	5.2%	4.6%	25.1%	28.5%	13.9%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

Although the total land distribution varies significantly by travel time category, the distributions of housing units is somewhat more evenly spread out because of different ratios of land area to housing units (Table V.3). Tracts with travel times less than 24 minutes account for 3.5% of the total land, but 10.9% of the total units, 6.9% of the single family units, and a staggering 20.4% of multifamily units. Conversely, for tracts with travel times over 39 minutes, these tracts accounts for 3.3% of the land and 5% of total housing units. The trends on the highest and lowest segments continues with the other three segments. The next lowest travel time cohort, 24 to 29 minutes, shares the same tend as the shortest time cohort with a disproportionate amount of housing units to land (14.6% of land and 22.2% of housing units). The middle cohort, 29 to 33 minutes, has about equal ratio of land area to housing units (29% to 30.1%). The second highest cohort, 33 to 39 minutes, has the inverse relationship of land to housing units with 49.5% of the land area, yet only 32% of the housing units.

Map 3 MARTA TOD Guidelines



In terms of growth in housing units between 2000 and 2005/09, the trends are not as clear as other variables. All five cohorts have similar changes in units; however, some generalizations still can be gleaned from the data. The two travel time cohorts with growth rates higher than the metro average are the lowest travel time cohort (<24 minutes) and the second highest cohort (travel times between 33 and 39 minutes). The first cohort had an overall growth rate of 26.3% compared to 24.5% overall with multifamily units outperforming the metro average with 24.6% growth compared to 17.1% growth. Conversely, the single family units was slightly less than the metro average (28.2% versus 28.8%). The 33 to 39 minute cohort had significant growth across single family and multifamily units. The number of single family units increased by 38.1% and multifamily units increased by 22.9%. The other three categories had growth rates at or significantly below the metro average.

The areas of growth based on meant travel time also aligns with what is expected. The majority of the fast growing 33 to 39 minute tracts are on the suburban fringe where the vast majority of the single family development has occurred. Because a lot of the highest time Census tracts were in the poorer sections of the city, these tracts did not see a lot of growth. The second highest growth rates were in the lowest travel times tracts, which is a sign that growth concentrated somewhat in areas that are closer to places of work.

The geography of the travel times aligns with what is expected (Map V.3). The majority of low travel times were within the perimeter, especially concentrated in the northwest to northeastern quadrants of the city. The lower travel times, overall, are extensions of the under 24 travel times and follow I-75, GA-400, and I-85. This distribution aligns, almost perfectly, with the areas of highest income brackets. Conversely, the lowest travel times are bifurcated between areas in the southwest quadrant of the city and a few tracts away from highways. Although these tracts in the southwest quadrant of Atlanta are close in distance to the region's major employment centers, they are also much poorer tracts with a higher percentage of people relying on public transportation. The remaining long travel time tracts are much further from the region's major job centers.

Discussion:

Although mean travel time is a fairly strong indicator of smart growth in many areas, it does have some weaknesses. A primary weakness is it loses some of its strength because of its correlation with income. The poorer tracts with long travel times in the southwest quadrant of Atlanta have many of the design features that favor smart growth, such as small blocks, dense housing, and access to transportation. Conversely, areas with low mean travel time, such as Buckhead and Sandy Springs, have more traditional suburban style development. Another weakness is that travel time is not necessarily correlated with travel distance. For example, in more suburban locations that have better access to highways and where residents walk less, travel times will be lower per a distance unit. Despite these weaknesses, the conceptual rationale and the actual geographic distribution align with areas that favor smart growth.

Commute by Walking

Methodology: The commute by walking variable is based on the 2000 Decennial Census. It was organized into five different percentage cohorts Below 2.5% minutes is the lowest threshold and represents the lowest correlation with smart growth. Greater than 25% is the highest threshold and represents the greatest amount of smart growth. Three additional intervals 2.5-5%, 5-10%, and 10-25% were also elected because of their loose natural breaks.

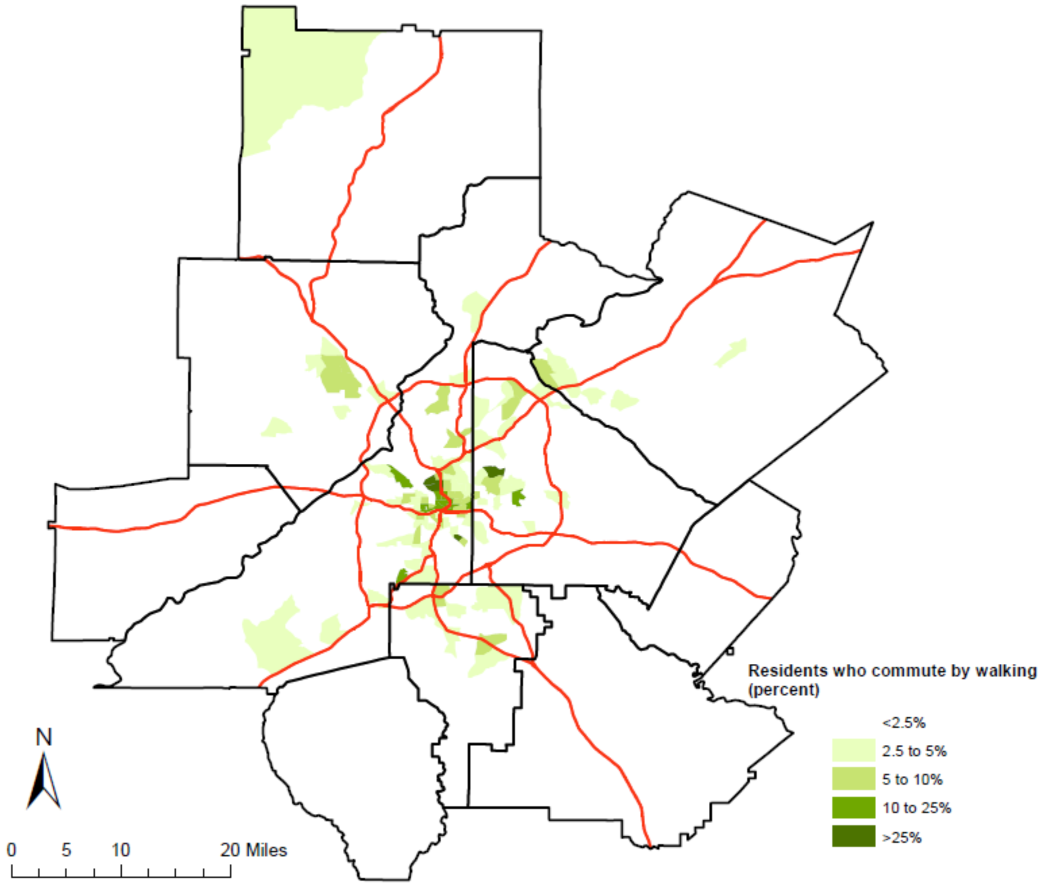
Results:

Table V.4: Percent Commute by Walking

		2000			2005/09			Change		
Walking	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
<2.5%	1,759,770	1,128,845	809,193	293,287	1,415,655	1,046,194	344,114	286,810	237,001	50,827
2.5 to 5%	145,215	141,608	63,112	76,374	163,672	77,517	84,018	22,064	14,405	7,644
5 to 10%	22,040	47,204	16,128	30,509	61,649	20,722	40,379	14,445	4,594	9,870
10 to 25%	4,209	11,381	2,666	8,804	12,840	3,450	9,313	1,459	784	509
>25%	1,961	2,226	660	1,523	3,647	623	2,993	1,421	(37)	1,470
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
<2.5%	91.0%	84.8%	90.7%	71.4%	85.4%	91.1%	71.6%	25.4%	29.3%	17.3%
2.5 to 5%	7.5%	10.6%	7.1%	18.6%	9.9%	6.7%	17.5%	15.6%	22.8%	10.0%
5 to 10%	1.1%	3.5%	1.8%	7.4%	3.7%	1.8%	8.4%	30.6%	28.5%	32.4%
10 to 25%	0.2%	0.9%	0.3%	2.1%	0.8%	0.3%	1.9%	12.8%	29.4%	5.8%
>25%	0.1%	0.2%	0.1%	0.4%	0.2%	0.1%	0.6%	63.8%	-5.6%	96.5%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

Tracts that have a lot of people walking are very low. In 2000, over 91% of the land and nearly 85% of housing units are in tracts that have less than 2.5% of residents commuting by walking (Table V.4). The remaining 9% of land, with greater than 2.5% residents commuting by walking, have a roughly proportional 9.3% of single family units, but account for 28.6% of multifamily units. Most of this disproportionate multifamily came from the 10-25% category, which has .2% of land, but 2.1% of total multifamily units, and the 5 to 10% category, which had 1.1% of land, but 7.4% of total units in 2000.

Map 4 Commute by Walking



Housing growth rates varied significantly among the different cohorts with few patterns emerging. Total housing units in cohorts above 2.5% increased by 19% compared to 24.5% overall. Despite this lower overall rate, there was some striking areas of growth, including the cohort with greater than 25%, which had an overall unit increase of 63.8%, or 1421 units. This high growth rate was driven entirely from increases in multifamily units, which nearly doubled, while the single family units actually decreased by 37 units.

The geographic pattern of commuting by walking is based on a combination of pedestrian-friendly urban design, employment locations, and general tract demographics. The tracts with the most walking are located primarily within the perimeter, which has more compact design with a higher percentage of roads with sidewalks (Map V.4). Moreover, the employment opportunities are much greater for residents nearby. For these reasons, Douglas, Fayette, Henry, and Rockdale counties have no tracts with greater than 2.5% of residents commuting by work by walking, In addition to design characteristics, demographics have a major role in the amount of walking. The tracts with the greatest percentage walking are around Georgia Tech and Emory University. Other tracts have high percentages have a higher percentage of poverty, especially in along the Buford Highway corridor, west side of Atlanta, and Clayton County.

MARTA: Minimum Tract Distance

Methodology: To measure the presence of public transit, a tract's minimum distance to Marta rail stations was calculated. A number of different methods were tested before arriving on a final method. Using the distance of a tract's centroid to the nearest Marta station was the initial plan; however, because of the Georgia Tech's ArcGIS license, this calculation could not be performed. Another initial thought was to have a category for tracts with Marta stations; however, because many of the stations were on an edge of the tract, this method would have not have accounted for the neighboring tracts that do, in reality, have a relationship with the Marta station. In the end, the minimum distances of a Census tract to Marta Station were selected based on the categories of less than a quarter mile, a quarter to a half mile, a half to one mile, and greater than one mile.

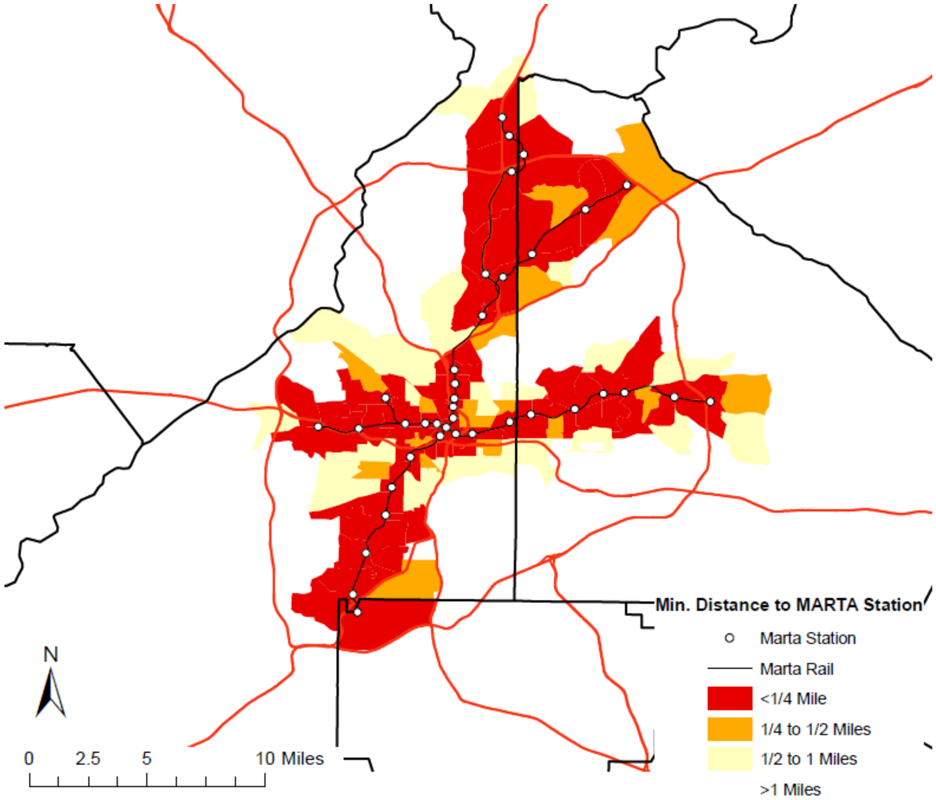
Results: The land and populations near Marta stations is minimal in the metro area. Less than six percent of the total land and less than 20 percent of total housing units are within a minimum distance of 1 mile of a Marta station in 2000. Of this 20 percent of total housing units, the 55% of the units are multifamily and 45% are single family, compared to the metro distribution of 1/3 units being multifamily and 2/3 being single family.

Table V.5: Distance to MARTA Station

		2000			2005/09			Change		
Distance to Marta	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Less than 1/4	59,359	146,025	63,789	81,665	174,839	77,267	96,346	28,814	13,478	14,681
1/4 to 1/2	15,489	36,241	16,366	19,785	42,853	19,161	23,375	6,612	2,795	3,590
1/2 to 1	26,041	65,072	32,208	32,638	79,515	41,475	37,595	14,443	9,267	4,957
More than a mile	1,832,306	1,083,926	779,396	276,409	1,360,256	1,010,603	323,501	276,330	231,207	47,092
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Less than 1/4	3.1%	11.0%	7.2%	19.9%	10.5%	6.7%	20.0%	19.7%	21.1%	18.0%
1/4 to 1/2	0.8%	2.7%	1.8%	4.8%	2.6%	1.7%	4.9%	18.2%	17.1%	18.1%
1/2 to 1	1.3%	4.9%	3.6%	8.0%	4.8%	3.6%	7.8%	22.2%	28.8%	15.2%
More than a mile	94.8%	81.4%	87.4%	67.3%	82.1%	88.0%	67.3%	25.5%	29.7%	17.0%
Total		100.0%	100.0%	100.0%	89.5%	93.3%	80.0%	24.5%	28.8%	17.1%

Few patterns emerge for growth rates. Although many of the tracts near Marta had high growth in the number of units, this disproportionately high growth was canceled out by tracts—primarily in the south and west sides of Atlanta—that had low growth rates or, in some instances, actually decreased the total number of housing units. Total housing units increased by 20.2%, single family units by 22.7%, and multifamily units increased by 17.3% for tracts within a minimum distance of one mile of a Marta station (Table V.5). The total unit and single family rates are about four and six percentage points, respectively, less than metro area averages, whereas the multifamily rate is approximately the same.

Map 5 Distance to MARTA Station



Discussion: For the purposes of the index, this method highlights tracts that should be recognized as having some smart growth potential based on their access to transit stations. However, to more accurately reflect development patterns, a different methodology based on Marta stations would need to be used. As is the case for many other variables, the Census tracts are often too large. A better method would use Census block groups or a combination of buffers. By using smaller counting areas around the transit stations, researchers could study the development patterns of areas that are actually accessible to Marta stations by walking. For one variable out of 12, this extra level of detail would not result in a different overall index; however, if one wanted to study more closely transit-oriented developments, more detail and nuance is necessary.

PATH: Minimum Tract Distance

Methodology: This paper uses more of a "checklist" approach based on the distance of a tract to the PATH Foundation's network of bike paths in Fulton and DeKalb Counties. A similar measurement methodology to the Marta Stations above was used with distances of less than a half mile, a half mile to one mile, one to two miles, and greater than two miles. Unlike the Marta station distances, which were much smaller in size, larger distances were selected for this variable because of the shorter times it takes to reach a path by bike than to a transit station by foot.

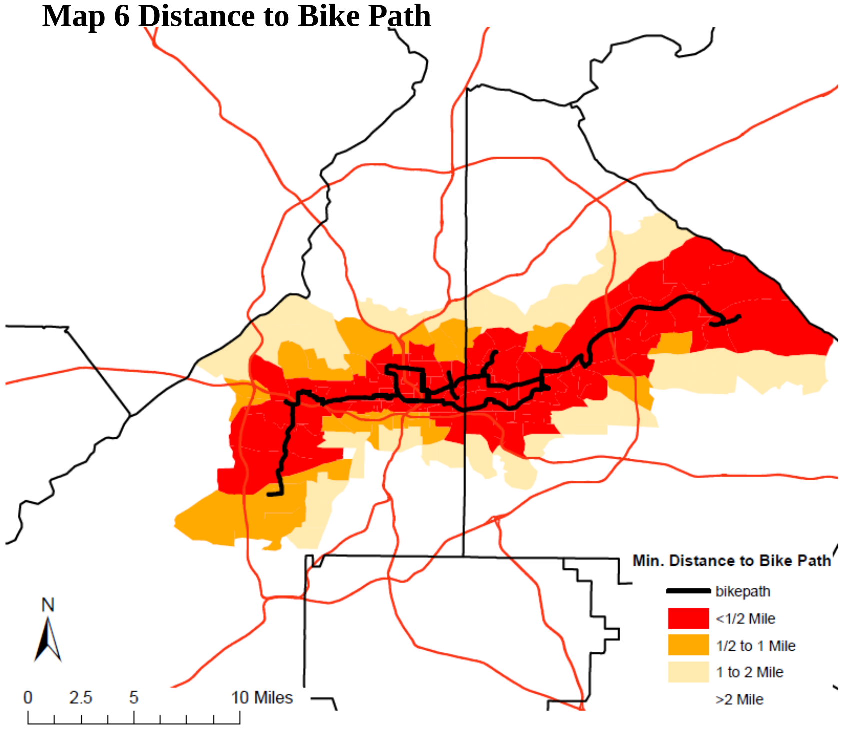
Results: Because the PATH connects some of the densest population areas in the metro area's core, the nearest tracts have a disproportionate amount of housing and overall growth. As shown in Map V.6, the PATH is primarily an east-west corridor accounting for only 3.1 percent of the total metro area's land within a half mile, but 10 percent of total housing units (Table V.6). These tracts closest to the PATH have an even higher proportion of multifamily units at 16.1% of the metro area's multifamily units. The tracts that are at a minimum of a half mile to one mile are located more in the western part of the PATH corridor, which is primarily a function of these areas having smaller Census tract sizes. The land in the half to one mile distance has a similar trend of greater amounts of multifamily (a breakdown of about 50/50 between single family and multifamily). The land within one mile to two mile begins to be more characteristic of the metro area as a whole with lower percentages of multifamily.

Table V.6: Distance to Bike Path

		2000			2005/09			Change		
Distance to Bike Path	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
Less than half mile	59,216	133,423	65,462	67,454	163,859	79,278	83,750	30,436	13,816	16,296
1/2 TO 1	22,094	48,744	23,723	24,881	58,613	29,592	28,781	9,869	5,869	3,900
1 to 2	38,925	70,256	45,884	24,310	82,296	54,103	27,553	12,040	8,219	3,243
More than two miles	1,812,960	1,078,841	756,690	293,852	1,352,695	985,533	340,733	273,854	228,843	46,881
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
Less than half mile	3.1%	10.0%	7.3%	16.4%	9.9%	6.9%	17.4%	22.8%	21.1%	24.2%
1/2 TO 1	1.1%	3.7%	2.7%	6.1%	3.5%	2.6%	6.0%	20.2%	24.7%	15.7%
1 to 2	2.0%	5.3%	5.1%	5.9%	5.0%	4.7%	5.7%	17.1%	17.9%	13.3%
More than two miles	93.8%	81.0%	84.9%	71.6%	81.6%	85.8%	70.9%	25.4%	30.2%	16.0%
Total		100.0%	100.0%	100.0%	90.1%	93.1%	82.6%	24.5%	28.8%	17.1%

Growth rates, based on distance to PATH, were variable. The tracts within a half mile of the path had growth rates of total units lower than the metro average, which was the result of low single family growth rates (Table V.6). Multifamily units increased by over 16,000 units, or 24.2%, which was seven percentage points higher the metro average for single family units. The half mile to mile and mile to two mile rates of growth were all less than the metro average. These lower growth rates are due to the greater proportion of tracts in the western part of the city, where there was less growth and higher amounts of nonresidential uses.

Map 6 Distance to Bike Path



Discussion: Using the bike path is, in theory, a strong measurement of smart growth, but it does not necessarily reflect the connectivity that smart growth tries to promote. In the example of the path, by only measuring distance to it, there is no discussion of the types of development and land uses that it connects. In this case, the path is primarily an East/West route, which connects a number of residential areas with Downtown and Midtown office districts, as well as Emory and Georgia Tech's campuses, but it misses many other employment centers and high density residential areas in the region. A better variable would be to use a method like Cervero and Kocklemen (1997) to identify the percentage of streets in a tract that are suitable for biking, or how much retail or office space is accessible by bike or a bike path. These alternative variables would provide a more rigorous methodology to capture biking as a reflection of smart growth.

Retail Jobs to Population

Methodology: For this study a ratio of a tract's retail jobs to population was used as a variable. Although other methods used store count or distance to store, a retail jobs variable provides a similar proxy. Moreover, these other variables just measures retail, which is fine, but by using a ratio to population, this measure begins to indicate mixed use at the tract level between residential and retail. In tracts with a low ratio, there is little presence of retail and the tract is more residential; in tracts with a high ratio (near or over 100%), the tract is more heavily retail, and probably commercial. For those tracts in the 25 to 75% range, there is a fair mix of retail and residential. This mix indicates the proximity of retail to housing units, and therefore, higher smart growth.

The calculation of retail jobs to population is based on Census Longitudinal Employer-Household Data and the Decennial Census Data. The retail employment, as defined by the two-digit NAICS code, was taken for year 2002, the earliest year available, at the Census block group level. This detailed block group level data was then aggregated for the Census tract level. This aggregated retail employment figure was then divided by the population for the tract to arrive at a tract ratio. The tracts were then classified into five dimensions: above 100%, 50-100%, 25 to 50%, 10 to 25%, and below 10%. The middle three categories that measure the range from 10% to 100% are the most highly correlated with smart growth. They represent areas that have a mix of residential and retail. Above 100% becomes too heavily dominated by retail with few residents nearby. Below 10% is too dominated by residential without the presence of local retail.

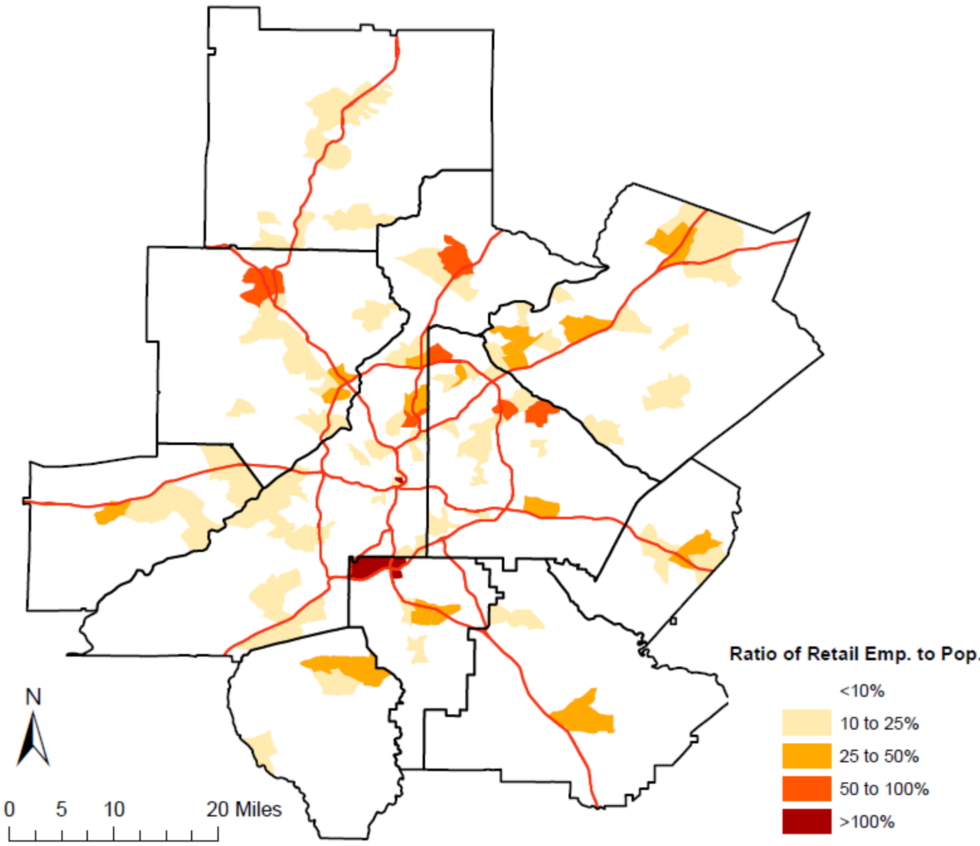
<u>Results:</u>

Table V.7: Retail Employment to Tract Population

		2000			2005/09			Change		
Retail Emp to Pop	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
<10%	1,650,387	1,093,336	757,786	311,443	1,361,165	978,654	358,605	267,829	220,868	47,162
10-25%	206,913	169,136	100,656	64,409	208,519	127,215	77,760	39,383	26,559	13,351
25-50%	52,929	46,144	23,222	22,294	57,862	30,708	26,741	11,718	7,486	4,447
50-75%	17,802	22,082	10,044	11,880	29,165	11,872	17,016	7,083	1,828	5,136
>100%	5,165	566	51	471	752	57	695	186	6	224
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
<10%	85.4%	82.1%	85.0%	75.9%	82.1%	85.2%	74.6%	24.5%	29.1%	15.1%
10-25%	10.7%	12.7%	11.3%	15.7%	12.6%	11.1%	16.2%	23.3%	26.4%	20.7%
25-50%	2.7%	3.5%	2.6%	5.4%	3.5%	2.7%	5.6%	25.4%	32.2%	19.9%
50-75%	0.9%	1.7%	1.1%	2.9%	1.8%	1.0%	3.5%	32.1%	18.2%	43.2%
>100%	0.3%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	32.9%	11.8%	47.6%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

The highest ratio of retail employment to population is at the intersection and near major the region's highways (Map V.7). The tract with the highest ratio is the location of Atlanta's Hartsfield-Jackson airport, which is dominated by the airport and only 566 total housing units in 2000 (Table V.7). The next grouping of tracts, those with 50-100% retail employment to population are primarily the tracts that are the locations of regional malls, such as around the Perimeter Mall and Town Center and Cobb, and major arterial roads with significant retail development, such as Windward Parkway in Alpharetta. These categories represented approximately 1% of the land, but 1.7% of total unit. The 10 to 50% categories are more scattered throughout the region, and are the locations of shopping centers geared towards the more local area. These categories represent over 12.4% of the total land and 16.2% of the total housing units.

Map 7 Retail Employment to Tract Population



Tracts with higher retail to population ratios tended to have higher growth rates, especially among multifamily units. Although this trend is most clearly articulated in the greater than 100% category, because so few people live in these tracts, this category represents only 224 new multifamily housing units. The 50-100% category housing units increased overall by 32.1% with an increase of 43.2% of multifamily units. The remaining categories (10-25% and 25-50%) grew more closely to the overall metro averages.

<u>Discussion</u>: Just because the area has a high retail jobs to population ratio is not indicative of smart growth. In Atlanta, the urban forms associated with many of these high retail job tracts are suburban-style strip malls and regular malls. These forms are widely noted (i.e. Chris Leinberger and Ellen Dunham-Jones) to be anti-smart growth. In the future, these tracts will hopefully develop with more smart growth attributes, such as the perimeter development, to encourage walkability and transit use. At this time in Atlanta, retail to jobs is only a small indicator of overall smart growth.

Street Length Per Square Mile of Developed Area

<u>Methodology:</u> Although there are many different ways to use streets as variable, the streets variable in this paper looks at the density of street length as a proxy for urban form. In older areas that have a block pattern, which is favored by smart growth practitioners for the

connectivity that promotes walking and density, there is a higher density of streets. In newer, more suburban areas, there is a lower density of streets. Other variables, such as block size or intersections could have been used, but in calculating a sample of these variables, these variables were strongly correlated with the easily calculated street density variable.

The streets density variable was calculated based on street length in already developed areas. Although streets are present in both developed and non-developed areas, developed areas was selected as a boundary to better reflect the development patterns of an entire tract. If the area of the whole tract area was used instead of the developed area in the tract, potentially compact developments in the larger, more rural tracts would be overlooked. Developed areas were calculated based on Atlanta Regional Commission's 2001 LandPro GIS data.

The streets data came from Census Tiger 2010 spatial data. While this data is more recent than many other data sources, because the measurement was limited to areas developed in 2001, the streets built after 2000 did not have much of an effect on the overall measure because few new streets were constructed in already developed areas. Some more modifications were made to the data, such as elimination of highways, including all interstate roads and GA-400. When the density measure was calculated, numbers below # were eliminated. These small numbers were mistakes due primarily to the misalignment of the tract layer with the streets layer. Like many other variables, five different categories were used for classifying street density based loosely on natural breaks in the data. Above 17.5 miles of streets per square mile of developed land was the highest category and below 10 miles of streets per square mile of developed land was the lowest category. In between the categories were divided into intervals of 2.5 miles.

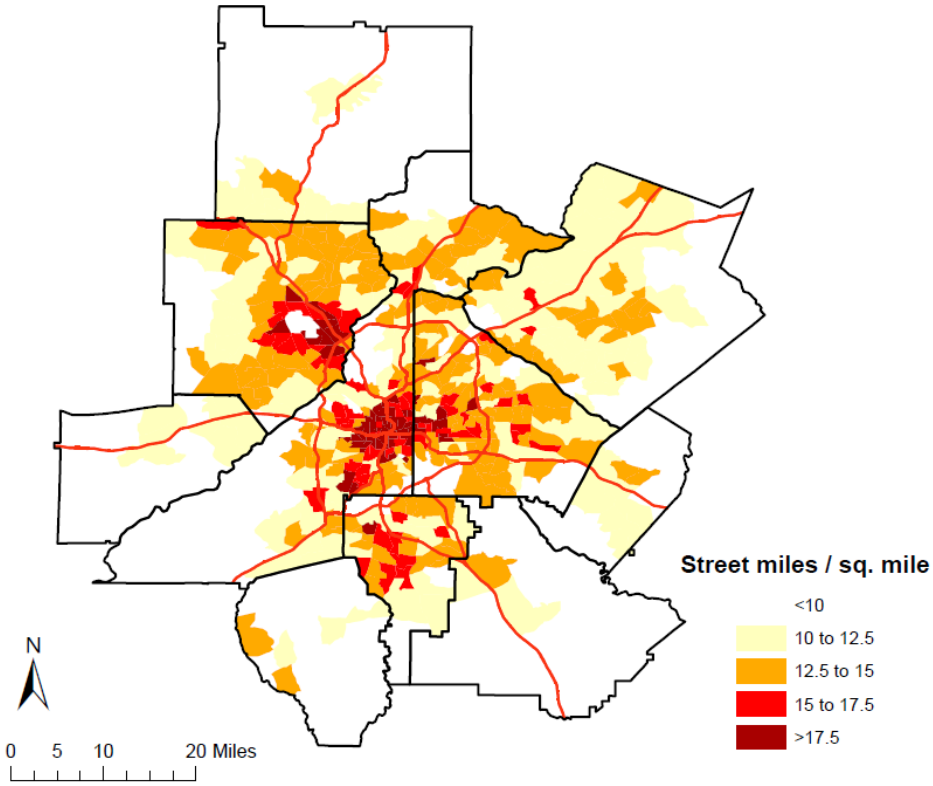
<u>Results:</u>

Table V.8: Streets per Square Mile of Developed Area

Streets Per Sq Mile of Developed Area		2000			2005/09			Change		
	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
<10	1,000,436	199,108	169,192	20,726	304,774	265,483	30,625	105,666	96,291	9,899
10-12.5	498,721	422,392	285,647	125,364	534,734	371,319	153,143	112,342	85,672	27,779
12.5-15	338,052	452,023	316,503	130,121	515,892	363,628	147,060	63,869	47,125	16,939
15-17.5	64,285	150,648	79,046	69,042	173,264	95,811	74,579	22,616	16,765	5,537
>17.5	31,703	107,093	41,371	65,244	128,799	52,265	75,410	21,706	10,894	10,166
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
<10	51.8%	15.0%	19.0%	5.0%	18.4%	23.1%	6.4%	53.1%	56.9%	47.8%
10-12.5	25.8%	31.7%	32.0%	30.5%	32.3%	32.3%	31.9%	26.6%	30.0%	22.2%
12.5-15	17.5%	34.0%	35.5%	31.7%	31.1%	31.7%	30.6%	14.1%	14.9%	13.0%
15-17.5	3.3%	11.3%	8.9%	16.8%	10.5%	8.3%	15.5%	15.0%	21.2%	8.0%
>17.5	1.6%	8.0%	4.6%	15.9%	7.8%	4.6%	15.7%	20.3%	26.3%	15.6%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

Compared to the highest category for other variables, the greatest street length variable is more spread out than other variables (Map V.8). Approximately 1.6% of the land has over 17.5 miles of street length per square mile of developed land, which is much higher than the upper cutoffs of other variables (Table V.8). Granted, these cutoffs are somewhat arbitrary, but they are all loosely related to natural breaks in the data. In 2000, the areas in the highest category had about 8% of total housing units, 4.6% of single family units, and 15.9% of multifamily units. The middle categories, 10-12.5, 12.5-15, and 15-17.5 miles per square mile, accounted for approximately 50% of the metro areas land and are found in the five central counties: Fulton, DeKalb, Clayton, Cobb, and Gwinnett. These areas had close to 80% of total housing units. The lowest level of street development made up 51.7% of the metro area's land, but 19% of single family units and 5% of multifamily units in 2000.

Map 8 Streets per Square Mile of Developed Area



Although the tracts are more widespread, higher density of streets is not associated with higher growth in overall units, single family units, or multifamily units. In the three upper categories (higher than 12.5 miles per square mile), growth is significantly below the metro average. The 10-12.5 category tracts have growth rates of 2.1, 1.2 and 5.0 percentage points higher than the average for total units, single family units, and multifamily units, respectively. The highest growth of housing units was dominated by the tracts with low street length in 2000, at 53.1% overall, 56.9% for single family units, and 47.8% for multifamily units.

Discussion: Street density is a particularly good variable for measuring smart growth because it includes some of the areas that other variables have overlooked. Because the street length is not necessarily related to population, this variable captures many areas in the western parts of the City of Atlanta that have a high density of streets and are not captured by other variables that are based more on population. These areas might have lost populations or are dominated by industrial or commercial lands. In areas with high densities, the street densities tends to also be high, which in an index, serves to reinforce the importance of density as a component of smart.

Parks

Methodology: This study uses a method similar to Miles and Song (2009) of measuring the amount of land in an area dedicated to parks. This paper uses a Park GIS file from the Atlanta Regional Commission. For tracts that had any park land, which was 435 out of 564 tracts, the amount of park land was calculated, resulting in about 92 square miles of park land out of the 2572 square miles of tracts that had some parks. This percentage was approximately 4%. The amount of park land for each tract was then calculated, and for those tracts with above the 4% average, the tracts were marked as "More than Average."

Results:

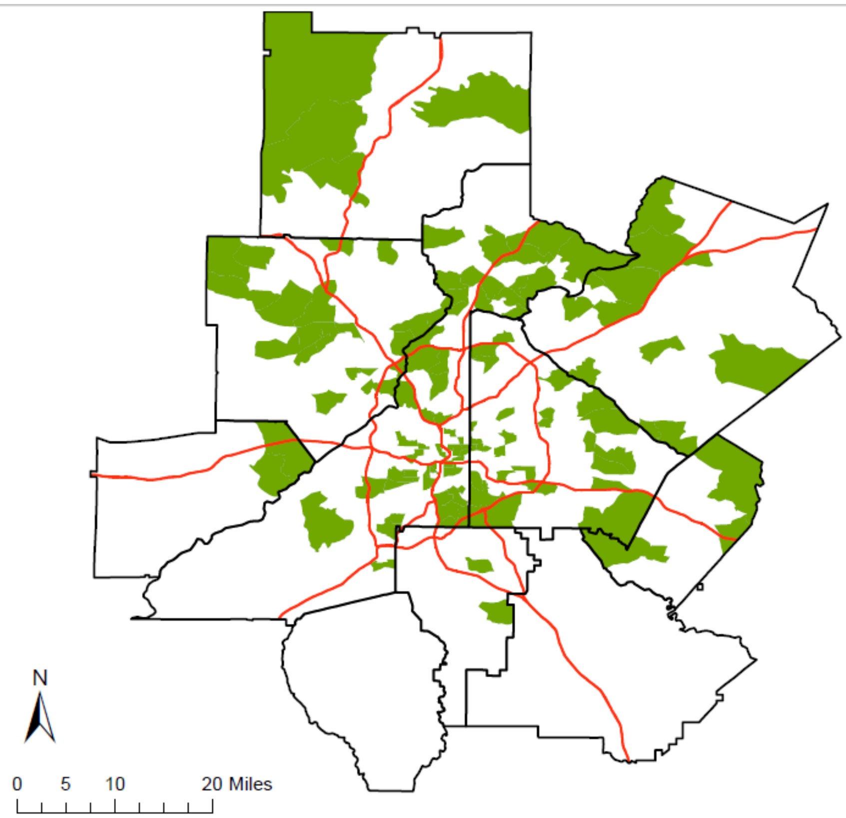
Table V.9: Parks Greater than Metro Average

		2000			2005/09			Change		
Parks>Metro avg	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
More than Average	456,465	302,704	200,695	96,816	379,877	262,946	112,458	77,173	62,251	15,642
Less than Average	1,476,731	1,028,560	691,064	313,681	1,277,586	885,560	368,359	249,026	194,496	54,678
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
More than Average	23.6%	22.7%	22.5%	23.6%	22.9%	22.9%	23.4%	25.5%	31.0%	16.2%
Less than Average	76.4%	77.3%	77.5%	76.4%	77.1%	77.1%	76.6%	24.2%	28.1%	17.4%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

Because of the great variation in the types of tracts that had "more than average" park land, the results of land distribution, base year units, and the change in units were the least consistent with the other smart growth measures. Approximately 24% of the metro areas land had more than average percentages of park land. In most other smart growth variables, the category associated with smart growth often had a disproportionate amount of housing units per the amount of land (Table V.9). For parks, the percentage of units was roughly the same with the percentage of land (24% of units on 24% of land). Similarly, because of the random geographic distribution of tracts with above average park land, the growth rates were fairly consistent among park lands and non-park lands. Single family growth in more than average park land tracts was the most different with 31.0% growth versus 28.8% overall for the metro area. This difference, however, is much less than the difference for many other variables.

Discussion: Unlike some of the other variables that are more indicative of smart growth (density, mixed uses, transit), parks and open space should be thought of as a secondary variable. For an area, it is a careful balance between having too much open space compared to the amount of land dedicated to development. Looking at Map V.9, park land in a tract is often not correlated with other smart growth; park land appears to be spread randomly throughout the region. Moreover, for tracts with smaller areas, there may not be a high percentage of parks within the tract, but residents may have access to a park nearby. A better measure may be to look at the distance to parks, or conversely, determine the amount of residents within a certain distance of the park. These measures would be further enhanced by using a smaller area of measurement such as a blockgroup.

Map 9 Parks greater than Metro Average



Livable Centers Initiative

Methodology: LCI geographic data from the Atlanta Regional Commission was used as the basis for this variable. Because this study was concerned about the smart growth in 2000, only the LCI tracts that were approved in 2000—the first year of the imitative—were included. The boundaries of the 12 different LCI areas in 2000 did not align with the tracts causing some tracts to only have a small portion in the LCI areas. Looking at the boundaries, a 30% minimum was chosen in order for the tract to be classified as LCI. This minimum eliminated # tracts from being classified as LCI.

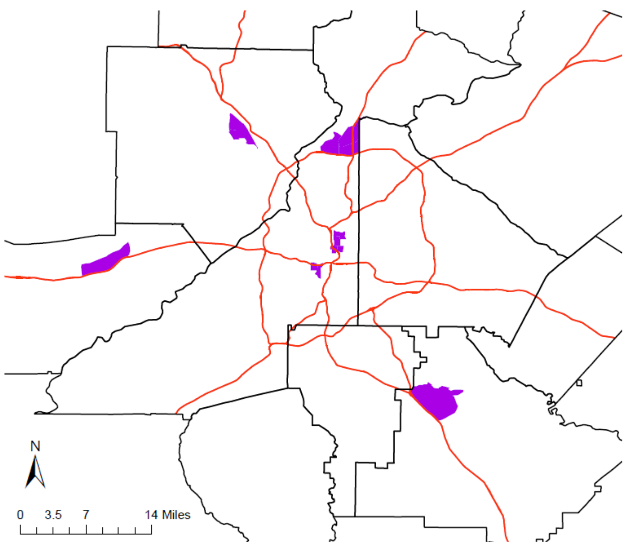
Results:

Table V.10: Livable Center Iniative (Greater than 30% Tract Land)

		2000			2005/09			Change		
LCI > 30%	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
LCI	19,989	35,975	13,674	21,518	43,199	15,034	27,569	7,224	1,360	6,051
No LCI	1,913,207	1,295,289	878,085	388,979	1,614,264	1,133,472	453,248	318,975	255,387	64,269
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
LCI	1.0%	2.7%	1.5%	5.2%	2.6%	1.3%	5.7%	20.1%	9.9%	28.1%
NO LCI	99.0%	97.3%	98.5%	94.8%	97.4%	98.7%	94.3%	24.6%	29.1%	16.5%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

LCI tracts represent a small amount of land total units, a small number of housing units in 2000, and not as dramatic rate of growth as was expected given the investment and planning emphasis. Approximately 1.0% of the total land, or about 32 square miles, was in an LCI tract in year 2000. These 32 square miles had about 2.7%, or 35,975, total housing units with about 40% of those units being single family and 60% being multifamily. The growth rates from 2000 to 2005/09 definitely favored multifamily, which grew at 28.1% versus 17.1% overall. The number of single family units, however, was much less at 9.9%, giving an overall rate of 20.1%, which was less than the metro average of 24.5%.

Map 10 Livable Centers Initiative (Greater than 30% Tract Land)



<u>Discussion:</u> Using the Livable Centers Initiative as a variable for smart growth provides a local component to understanding smart growth in metro Atlanta. The Atlanta Regional Commission has prioritized and targeted funding towards these communities to promote many of the principles of smart growth. If this study were to be replicated for other metro areas, researchers could use a similar policy variable, such as municipalities within a metro area that have certain smart growth policies or smaller neighborhoods that are actively promoting certain initiatives. It is also important to note that these areas are targeted by policy to promote smart growth, but do not necessarily have existing smart growth qualities. Although the goal of the program is to

introduce more smart growth principles, research would need to be conducted to explore the effectiveness of policies in introducing a higher level of smart growth.

Land Use Diversity

Methodology: Although the land use diversity can be measured in multiple ways, and can be captured partially by other variables, the methodology for this study is based on comparing residential to nonresidential land uses in a tract. First, the Atlanta Regional Commission's 2001 LandPro data was used to measure the percentage of developed residential land and percentage of developed nonresidential land for each tract and for the entire 10 county metro area. A score was created for each tract based on subtracting the squared percentage of nonresidential land from the squared percentage of residential land from 1. This decimal was then multiplied by 100 to arrive at a numerical score. This method gave a 50% residential to 50% nonresidential the highest score with any other mixes being lower.

In addition to the calculations at the tract level, the metro area land use diversity was calculated with a score of 31. Any tracts with a score above 31 could be considered to have higher diversity than the metro average. While a two category more versus less diverse could have been used, a range was used for this variable. The highest level of diversity was greater than 42 and the lowest was below 12. The second highest, 32 to 42, was selected because of a natural break and it approximated the metro average cut off of over 31. Two other categories, 12 to 22 and 22 to 32 were also used to signal low to medium land use diversity.

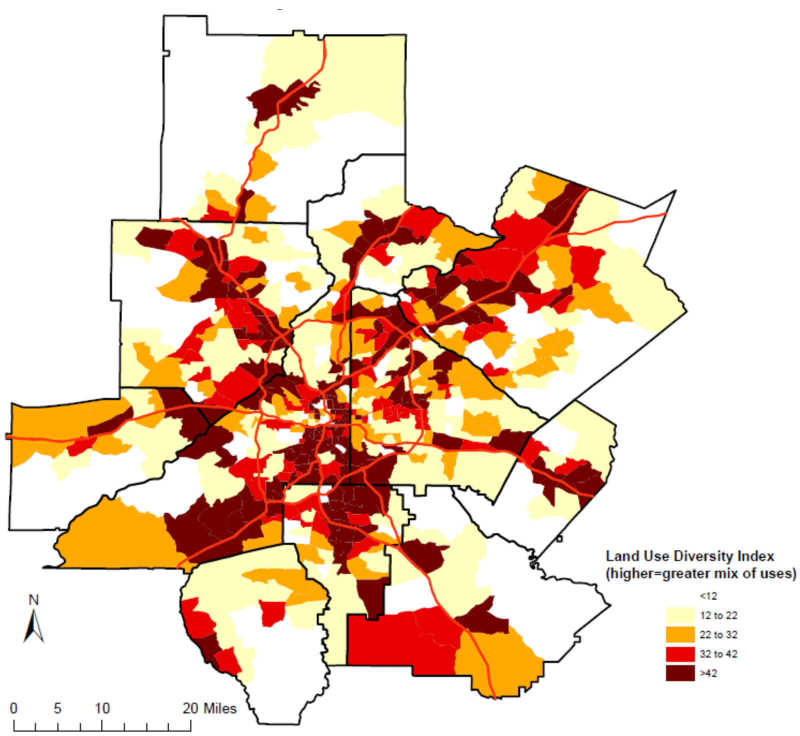
Results:

Table V.11: Land Use Diversity Score

		2000			2005/09			Change		
Mixed Land Use Index	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
<12	598,025	211,294	186,269	20,451	281,866	252,499	24,875	70,572	66,230	4,424
12 to 22	534,974	351,137	276,700	67,054	438,705	350,760	81,312	87,568	74,060	14,258
22 to 32	297,780	229,179	159,693	63,607	278,416	198,857	73,989	49,237	39,164	10,382
32 to 42	205,496	208,562	120,065	83,936	248,573	151,171	93,174	40,011	31,106	9,238
>42	296,922	331,092	149,032	175,449	409,903	195,219	207,467	78,811	46,187	32,018
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
<12	30.9%	15.9%	20.9%	5.0%	17.0%	22.0%	5.2%	33.4%	35.6%	21.6%
12 to 22	27.7%	26.4%	31.0%	16.3%	26.5%	30.5%	16.9%	24.9%	26.8%	21.3%
22 to 32	15.4%	17.2%	17.9%	15.5%	16.8%	17.3%	15.4%	21.5%	24.5%	16.3%
32 to 42	10.6%	15.7%	13.5%	20.4%	15.0%	13.2%	19.4%	19.2%	25.9%	11.0%
>42	15.4%	24.9%	16.7%	42.7%	24.7%	17.0%	43.1%	23.8%	31.0%	18.2%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%

Land use diversity is spread across the region. Unlike some variables that are more smart growth intensive are more concentrated in the region's core with some outliers at key junctions in the region, diverse land use primarily follows the region's highways with some outliers away from the highways. Moreover, the amount of land use diversity index is more evenly spread in terms of acreage. The lowest amount of diversity represents 30.9% of total land, while the highest amount of diversity represents 15.4% of the land. These percentages are much closer than nearly every other variable. The greater the diversity of land use is also correlated with more housing units, especially multifamily units. The highest category, above 42, represents 15.4% of the land, but 24.9% of the total housing units and 42.7% of multifamily; whereas the lowest category, less than 12, represents 30.9% of the land, but 15.9% of total housing units and 5.0% of multifamily units.

Map 11 Land Use Diversity Score



The growth rates, however, do not correlate with the 2000 distribution. Higher growth rates were common in the tracts with less diverse land uses and lower growth rates were associated with the tracts with more diverse land use. For instance, in tracts with a score of less than 12, total housing units grew by 33.4% versus 23.8% for tracts with a score greater than 42. The trend, however, can be somewhat misleading when only looking at percentages. Although multifamily in low diversity tracts increased by 21.6% versus 18.2% in high diversity tracts, the real number of multifamily units in diverse tracts was eight times as high (32,018 versus 4,424).

Like many of the other variables, a fundamental weakness of the land use diversity index is the size of the Census tracts. Because many of the tracts are large, even if there is a mix of residential and nonresidential land uses, it does not necessarily mean that the land uses are actually integrated. In fact, given the large number of tracts, especially in suburban locations, that have greater land use diversity than the regional average, it is likely that the uses are actually quite segregated.

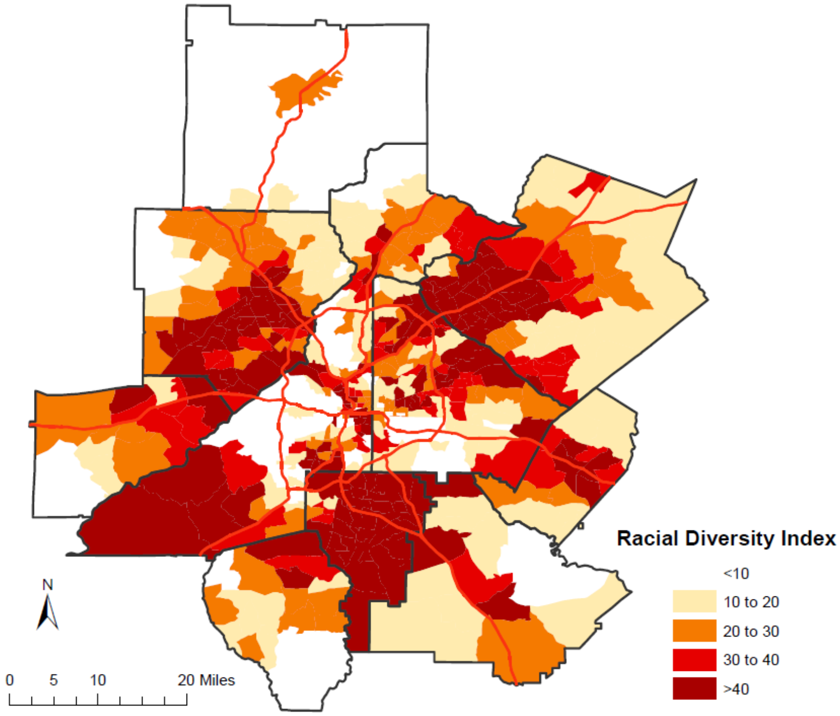
Discussion: There are a number of alternative ways to more accurately measure the presence of integrated, mixed uses. Rather than relying on the tract percentage of residential versus nonresidential land uses, more analysis could be done of the spatial spread of these uses. For instance, a higher diversity tract would have smaller areas of residential more interwoven with nonresidential. Another alternative would be to rely exclusive on mixed-use zoning. A more labor intensive way, used by many of the studies, would involve a more detailed, nuanced approach of looking at the nearest locations of retail and office to residential. Some of the other variables, such as retail to population and average commute time, begin to do this, but a more targeted approach would yield a variable that describes mixed use better.

Racial Diversity

Methodology: Because none of the literature includes racial diversity in their indexes, the methodological precedent I chose was based on the land use diversity index. Unlike the land use diversity index, which had only two variables (residential and nonresidential), the racial index had three variables from the 2000 Decennial Census, percentage White, percentage Black, and percentage Asian). A score was created for each tract based on subtracting the squared percentage of White, the squared percentage of Black, and the squared percentage of Asian from 1. This decimal was then multiplied by 100 to arrive at a numerical score. This method gave 1/3 White, 1/3 Black, and 1/3 Asian the highest score with any other mixes being lower. In the map and data below, five categories were created based approximately on natural breaks (below 10, 10 to 20, 20 to 30, 30 to 40, and greater than 40). Because racial diversity is only a secondary component of smart growth, in the final smart growth index, only tracts that had a score higher than the metro average were counted.

Results: The greatest racial diversity is in areas that are not represented by the other smart growth variables (Map V.12). In the core of the region and select areas on the edge of the 10 counties, there is great racial homogeneity. The southwest and southeast sides of the City of Atlanta are predominantly black, whereas the northwest side of the city and most of Cherokee County are predominantly white. These low diversity areas with scores below 20 account for about 50% of the region’s land. Significant racial diversity can be found in large areas of Gwinnett County, DeKalb County, and Clayton County. These tracts with the highest amounts of diversity account for just over one-fifth of the metro area’s land. These areas almost cluster in a loop around the perimeter near the major highways.

Map 12 Racial Diversity Score



Housing distributions in 2000 favor areas with greater diversity; however, the changes in units from 2000 to 2005/09 favored the less diverse areas. In 2000, the most diverse category, above 40, had 30.5% of total units, 25.2% of single family units and 41.4% of multifamily units, even though it accounted for only 20% of the land. The least diverse category, which accounted for over 26% of the land, accounted for only 15% of total units. Although these trends appear to reveal some type of preference for diverse housing, in actuality, the numbers are likely driven by Cherokee County's huge amount of acres and relatively little development. Cherokee County also skews the growth statistics. Because of the large amount of growth in Cherokee County during the 2000s, the total units in low diversity areas increased by 27.9%, compared to 24.5% overall. Conversely, the total units in the most diverse areas increased by only 19.1% . In real terms, however, the least diverse areas increased by 55,000 units versus 77,000 units in the most diverse areas.

Table V.12: Racial Diversity Index

		2000			2005/09			Change		
Racial Diversity Index	Acres	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	Total Units	SF Units	MF Units
<10	504,513	197,521	141,928	51,575	252,728	187,994	60,536	55,207	46,066	8,961
10 to 20	477,850	291,587	227,264	58,250	376,565	296,568	74,684	84,978	69,304	16,434
20 to 30	327,150	253,304	179,818	69,509	313,524	227,335	81,860	60,220	47,517	12,351
30 to 40	196,423	183,215	118,221	61,344	231,433	151,790	76,205	48,218	33,569	14,861
>40	427,259	405,637	224,528	169,819	483,213	284,819	187,532	77,576	60,291	17,713
Total	1,933,196	1,331,264	891,759	410,497	1,657,463	1,148,506	480,817	326,199	256,747	70,320
		Total Units	SF Units	MF Units	Total Units	SF Units	MF Units	^Total Units	^SF Units	^MF Units
<10	26.1%	14.8%	15.9%	12.6%	15.2%	16.4%	12.6%	27.9%	32.5%	17.4%
10 to 20	24.7%	21.9%	25.5%	14.2%	22.7%	25.8%	15.5%	29.1%	30.5%	28.2%
20 to 30	16.9%	19.0%	20.2%	16.9%	18.9%	19.8%	17.0%	23.8%	26.4%	17.8%
30 to 40	10.2%	13.8%	13.3%	14.9%	14.0%	13.2%	15.8%	26.3%	28.4%	24.2%
>40	22.1%	30.5%	25.2%	41.4%	29.2%	24.8%	39.0%	19.1%	26.9%	10.4%
Total		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	24.5%	28.8%	17.1%